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THE

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THE PAY AND STATUS OF ENGINEERS.

CONSIDERING the training they have to go through, the expense of a scientific education, the labour involved in acquiring a proper knowledge of chemistry and physics that is essential to an engineer, and the arduous practical work during a well spent pupilage, there can be no doubt that the pay of engineers is insufficient. We believe that one of the principal reasons for this is the absolute ignorance of the details that go to make an engineer in the minds of those who so often have the ordering of salaries. There are probably few of our engineering readers who do not know where hundreds or thousands of pounds are being wasted in industrial concerns from lack of knowledge on the part of the management.

An engineer may point out to his board of management or his individual employer that by an expenditure of so much, an annual saving of 10, 20, or 30 per cent. on the cost of production may be secured. One of the commonest answers to this statement is that the employer himself cannot see how such an economy can be effected, and he refuses the outlay unless the engineer can show him how the saving is to be made. Now, to do this, it would be necessary to put him through a course of training similar to that in which the engineer graduated, and to provide him with the requisite intelligence to absorb it all. The mere commercial man would then have become an intelligent engineer. Even a two years' training in engineering practice would be a valuable asset for the business man who had the ability to absorb the lessons. It might probably cause him to lend an appreciative ear to suggestions for better systems of work, or improved plant and tools, and it would enable him to understand when the proposals put before him contained the promise of success or the certainty of failure.

There are many undertakings of various kinds that are paying paltry dividends to shareholders and sending twice the amount up the chimney, or down the drain, or paying it away in wages to men to drive files instead of attending to grinders or machine tools, while in other cases a lost dividend is pointed at by the finger of the vacuum gauge.

It is ignorance of facts, and lack of proper training, that has done so much to damage English business. It is not that English engineers do not possess a thorough grasp of their business, but that those who control matters are woefully short of practical knowledge, and are apt to pay far more attention to the man of talk than to the man of deeds. Thus the glib speaker who informs the monied man that he has a new invention that will revolutionise everything, and that the engineers have all been wrong and groping in the dark for all these years, finds ready and willing ears to scoop up the new truth!

There is another phase of the question also that has sprung up of late years, and manifests itself in the patchwork

appearance that characterises so much of modern work. So-called men of business, dispensing with engineers, order plant from various firms. Perhaps each contractor supplies good enough material, and the various things are assembled and put together and coupled up and set to work, but there is a general lack of unity of design and a strange incongruity of parts and very considerable misproportion. We have known a 28 ft. × 7 ft. Lancashire boiler to supply steam to an economical engine of over 400 I.H.P. Yet we have seen this same proportion of boiler put down to turn a mean load of about 50 H.P., purely on speculation and without any foreseen knowledge as to whether the engine or boiler was the excessive item.

The position of engineer to a non-technical employer is not a very enviable one; he is often called upon to make bricks without straw. There is a story told of an American general manager who resolved to reduce expenses, and he therefore cut down the engineer's requisitions by one half. One was for a new main driving belt 100 ft. long. The belt duly arrived, but it was only 50 ft. long. This is a good illustration, even if but a yarn, of the quality of the ordering to which engineers are subject. We do not go so far as to say engineers ought not to be supervised in their expenditure, but we do say they should be intelligently supervised, and we are quite sure that most frequently this is not the case.

In some cases it is the engineers who are to blame, especially in the ranks of consultants. There are those who, anxious to become millionaires, undertake duties far too numerous and too heavy for them to supervise fully. The result is that all manner of bad work is done in their names, and it would perhaps surprise some engineers if they could hear the criticisms upon their undertakings that practical experts so often make. Work is being constantly carried out by men on a commission basis of thousands of pounds, only to be afterwards put straight by the poor resident engineer at a small salary. This sort of thing brings discredit on engineering and reflects on all engineers, to the detriment of the pockets of the younger men and the reputations of the over-greedy themselves.

Some of the very worst jobs never do see the light, for they are amended by the resident engineer before being allowed to work, and in this way the consultant's reputation is saved, and he may even add to it through the timely efforts of the engineer-in-charge. But engineers-in-charge compare notes with their friends, and the consensus of opinion is a very different thing from the bell-wether opinions of aldermen, councillors and *hoc genus omnes*.

Blocking the Traffic.

THE *Times* of Monday, August 5th, contained the following note in connection with the Middlesex Sessions :—

> A number of grand jurymen failed to answer when called, and were fined £10 each. Later in the morning they appeared, and explained that they all lived in Chiswick and that neighbourhood, and had travelled by the new electric tramway. This morning there was an organised blocking of the way in the narrow part of the road at Brentford; the tradesmen living there objected to move their carts every time a tram came by, and took concerted action to test the question. The Court accepted this explanation, and withdrew the fines which had been imposed.

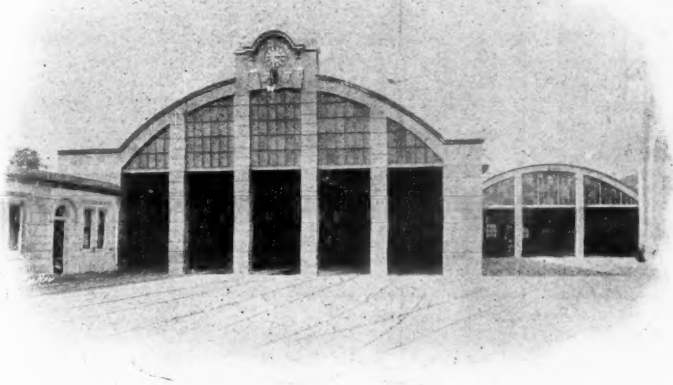
We shall await the result of the test action with considerable interest. A tramway company is the creature of Parliament, which can only block or otherwise interfere with the traffic along the roads when duly authorised in that behalf. The question, therefore, will arise, Does the right to run a tramway along the street involve the right to order a tradesman or any other person whose premises have a frontage towards the street to move any cart which may be standing there temporarily? We have often heard of tradesmen appearing to oppose electric tramway schemes in Parliament on the ground that the proposed track is to be laid too near the kerb. Such opposition has often proved successful, but the question whether, when the track has been laid and the obstruction has been caused, the tradesman who is using the highway for a lawful purpose has any right to complain does not appear to have arisen in the Courts. Without reference to the provisional order or special Act under which the Brentford tramways are worked, it would seem that the tradesmen have got hold of the wrong end of the stick, for it provides by Sec. 50 of the Tramways Act, 1870, that, "If any person, without lawful excuse (the proof whereof shall lie on him) wilfully does any of the following things; namely . . . . does, or causes to be done, anything in such a manner as to obstruct any carriage using a tramway, or to endanger the lives of persons therein or thereon, or knowingly aids or assists in the doing of any such thing, he shall, for every such offence, be liable (in addition to any proceedings by way of indictment or otherwise to which he may be subject) to a penalty not exceeding £5." Unless there is anything in the provisional order or special Act excluding the operation of this section, it would seem as if the tradesmen, in doing what they have done, subject themselves to proceedings for penalties. The fact of their having combined together would be strong evidence of an intention to deliberately obstruct the trams. In our view the Act of Parliament must be taken to have given the tramway company an implied right of asking the tradesmen to move their carts whenever necessary.

Experiments with Wireless Telegraphy in the Mediterranean.—During the recent manœuvres in the Mediterranean, some very interesting tests were made with the Fleet's equipment of wireless telegraphy apparatus, illustrating the uses to which it may be put in war time. On leaving Gibraltar, for Rapello (near Genoa), the Fleet steamed out in a southerly direction, in single line ahead, and by the time the last ship had left the anchorage, the ships stretched right away across the Straits. At a given signal they all turned simultaneously to an easterly direction, and then each ship was put upon a certain course laid down previously in a specially-constructed chart. The chart was designed to give an enormous area of search, and showed the course which each ship would take during the three days' cruise. The ships, on leaving the Straits, diverged until they were at a distance which averaged 12 or 15 miles from one another, and their speeds were regulated so that no ship should be in advance of any other during the cruise. Thus, if the centre ship of the line be supposed to have taken a straight course to Rapello, the ships on either side of her steered over curves that were more pronounced according as they were placed further away towards the wings of the line. The outside ships, having a greater distance to cover, went at their utmost speed, and the inside ships regulated their speed accordingly. Steaming in this manner the whole fleet could be concentrated at any point a few hours after receiving a signal, and the ships fitted with wireless telegraphy were distributed, for the purpose of passing along such signals, at equal intervals throughout the line. The experiment was successful, and proved that with the aid of these ships an order to concentrate could be received and carried out in a far shorter space of time than would have been possible with flag or long-distance semaphore signals. As the wireless message was received by each telegraph ship she could collect the other ships in her vicinity with ordinary signals, closing in towards them as necessary, and thus the whole line had received the signal in a fraction of the time it would have taken by the ordinary methods, for instead of the order being passed gradually from the flagship, which was the most northern, down through the line to the southward, it appeared from several points simultaneously. The enormous advantage of transmitting signals quickly along such a line of ships in extended order will be appreciated even by those who are not familiar with naval tactics. On this occasion a telegram received by H.M.S. *Tyne*, from Malta, was transmitted right up the line to H.M.S. *Renown* off Toulon.

LONDON UNITED TRAMWAYS.

(*Concluded from page* 177.)

The extensive sheds at this depôt are capable of accommodating 100 electric cars, and a complete series of repairing shops also has been provided. The sheds, which contain 11 lines of track in all, are furnished with pits for inspection



Car Sheds at Power Station.

purposes, and all the movements of the cars to, from and within the sheds and shops are effected electrically by the trolley wires.

The machine shop is provided with wood-working plant and machine tools for car repairs, amongst the wood-working machines being the following:—A 30-in. circular saw, 12-in. circular combination saw, planer, panel planer, chisel mortiser with boring attachment, horizontal mortiser and tenoner, and double-spindle mortiser. With these machines all repairs to car bodies can be effected. They are driven by underground shafting by a 30-H.P. motor located in the pit. This part of the shop is also well furnished with carpenters' benches.

The north end of the structure is devoted to the repair of the motors and car trucks, and is provided with vertical boring machines for boring wheels and bearings; a grinding lathe, suitable for grinding both wheels on their axle at the same time; a 32-in. gap lathe, a vertical turret lathe, two 8-in. screw-cutting lathes, a radial drilling machine, and vertical drilling machine and shaper. These are driven in a similar manner to the wood-working machines by a 20-H.P. motor, and there are also two smiths' hearths, supplied with draught from a centrifugal fan driven by a 5-H.P. motor, which also drives an emery grinder for dressing castings. A large amount of space is here allotted to benches fitted with vices, &c. At the north end is an electric traverser, working over the tracks in the shop and over three tracks in the running shed. The pits are provided with hydraulic jacks for removing the motors, and a 3-ton overhead traveller is also provided for lifting purposes. As all the motors in the repairing shop and throughout the depôt generally are controlled by automatic switches, they can be operated by the men without risk.

The administrative offices, the power station, the car sheds, the repairing shop, and the open parts of the depôt are lighted electrically by means of incandescent and arc lamps.

Practically the whole of the overhead lines are carried out on the "span wire" system. The overhead material was supplied by Messrs. R. W. Blackwell & Co. and erected by the Tramways Company. The side standards are formed of steel tubes, and three grades of these are used, able, when set 6 ft. in the ground, to stand stresses of 700 lbs., 1,000 lbs., and 1,500 lbs. respectively, applied 30 in. from the top, with a temporary deflection of not more than 6 in.; and stresses of 1,200 lbs., 1,760 lbs., and 2,600 lbs. respectively applied in the same manner, with a permanent set of not more than $\frac{1}{2}$ in.

These standards are bedded 6 ft. in concrete, which completely fills the holes dug to receive them, and which is thoroughly tamped down during the process of filling. The radial thickness of the concrete round the standard is 8 in. The lower end of each standard rests on a cast-iron plate. The concrete used was composed of one part best Portland cement to five parts clean gravel or broken stone, mixed as required and used fresh. The standards are planted with a sufficient rake to compensate for the strain caused by the bracket arm and span and trolley wires when erected.

The frogs and crossings were specially designed by one of the company's engineers, and erected by the company's staff.

The trolley wire is hard drawn copper wire of No. 0 B. and S. gauge, having a conductivity 98 per cent. of that of pure copper. The diameter of this wire does not vary more than ·0004 in., and the weight per 1,000 yards is 960 lbs. The maximum working stress will not exceed 2,000 lbs., and the breaking stress is 5,000 lbs. While the system generally is constructed with span wires, there is a special example of centre pole construction through Ealing, and in Southall-Norwood, Uxbridge Main Road, side bracket suspension is introduced. The trolley wires throughout are suspended at a height of not less than 21 ft. from the ground, except, of course, under the railway bridges, in which case they are splayed out, and are protected by a wooden troughing.

Bogie Car.

The entire route is divided into half-mile sections to meet the requirements of the Board of Trade, and at each half-mile section two section boxes are provided. This constitutes one of the most distinctive features of the system, as each trolley wire has its own feeder and distributor, and each of these can be disconnected at these section boxes. The distribution is thus duplicated throughout, forming an ideal system, providing against breakdowns either in the cables or in the overhead equipment.

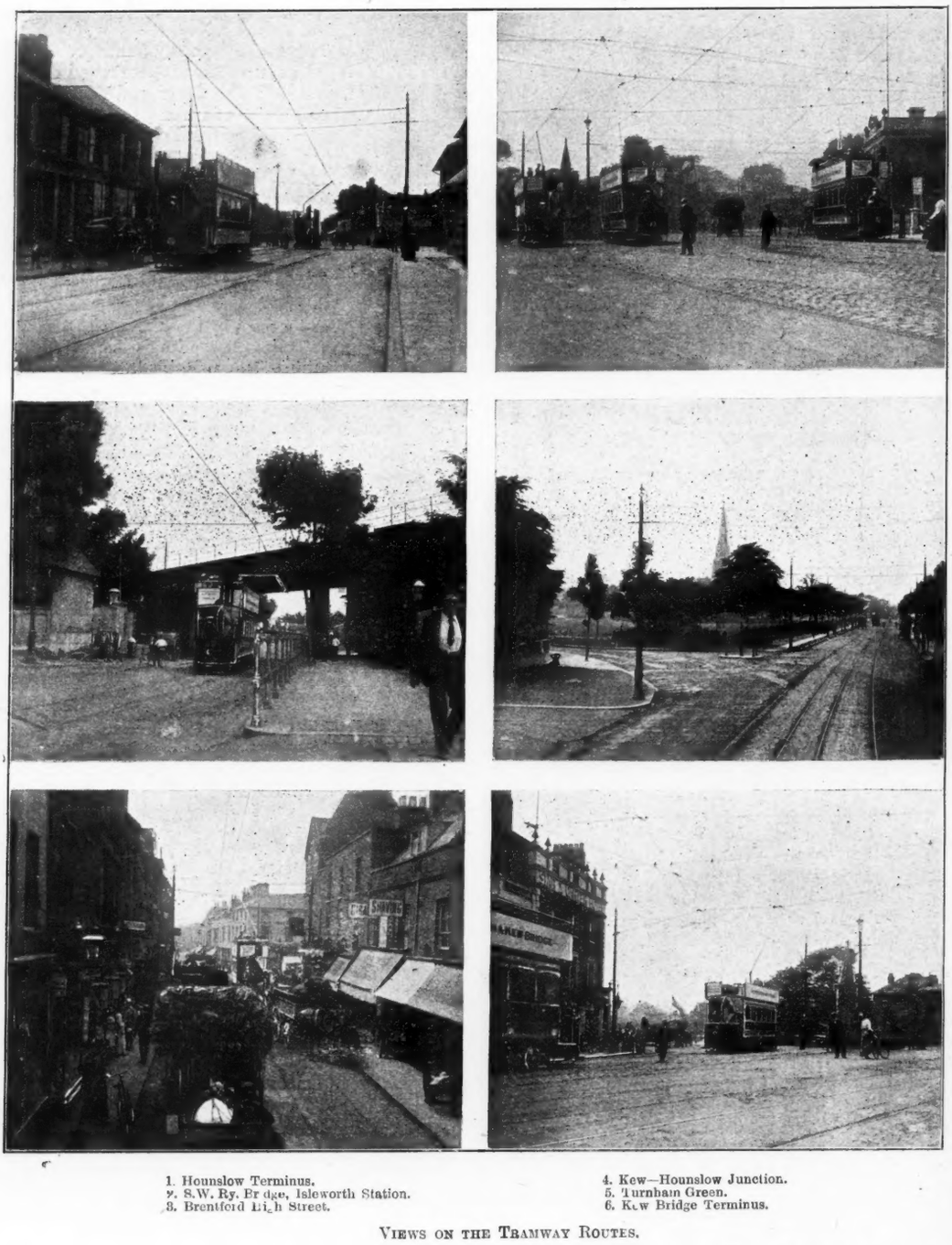
The section boxes are all equipped with telephone plug

boxes, supplied by the General Electric Company (1900), Limited. These are connected with a 16-line annunciator at the head office, which is also connected with the various departments in the offices, thus providing a complete system of intercommunication between the respective departments and all parts of the lines.

The electric current is carried for distribution over the system by means of lead-covered paper-insulated cables, drawn into wrought-iron cement-lined ducts laid under the footpaths or between the tracks. As many as 42 of these ducts radiate from the central power station. The pipes are laid at a minimum depth of 18 in. from the surface of the roadway to the top of the concrete, and they run as straight as possible from manhole to manhole. They are laid on a bed of concrete not less than 3 in. thick, composed of Portland cement, one part; clean, sharp sand, three parts; and broken stone, five parts. This concrete is mixed as required, used fresh, and allowed to stand until it acquires its initial set. The lengths of pipe are fitted together with a Portland cement fillet, gauged neat, turned round and over all the joints. Each layer of pipes is covered and completely surrounded with concrete, extending 3 in. on each side.

As before mentioned, the whole of the feeding arrangements are duplicated. There are two distributors running throughout the entire system, each of 0·2 sq. in. section, and connected in at every half-mile section, being thus in parallel with the trolley wires throughout. In addition to this, the feeders are tapped to the distributors at approximately every one and a half miles, and earth return cables, of 0·5 sq. in. sectional area, are connected to the tracks in the middle of Brentford and on the Acton line. These returns are connected to the booster in the station, and the lead covering of the whole of the cables is bonded to the man-holes and to the rails throughout the entire system. The whole of the cables were supplied by the National Conduit and Cable Company.

The system now opened consists almost entirely of double



1. Hounslow Terminus.
2. S.W. Ry. Bridge, Isleworth Station.
3. Brentford High Street.
4. Kew—Hounslow Junction.
5. Turnham Green.
6. Kew Bridge Terminus.

Views on the Tramway Routes.

track. The rails are of steel, of the very best quality, made from first-class ores. The weight of the rails is 92½ lbs. per lineal yard, and they are rolled in 36 ft. lengths.

The bed on which the rails are laid consists of concrete 6 in. thick, composed of seven parts Thames ballast and one part Portland cement. This is covered with a floating of sand and cement, 1¼ in. thick, on which are laid the wood blocks, the joints being afterwards run in with pitch. The sand and cement floating is composed of four parts clean sharp sand and one part Portland cement.

The fish-plates are also made from steel of the very best quality, and are very tough, with no brittleness, the bars being rolled from blooms of sufficient sectional area to secure this. The weight of a pair of fish-plates is 92½ lbs.

The rails are double-bonded throughout. At every joint there are two copper bonds of 0000 B. & S. gauge, with cross bonds every 40 yards.

The tramways are paved throughout with hard wood Jarrah blocks, tar-grouted and top-dressed with Portland cement.

The rails were laid and all track work done by the company's own staff.

The lines through the Hanwell and Hounslow districts are fed by currents transmitted from the central power station in the first instance at a pressure of 5,000 volts. The sub-stations from which the current is then locally distributed are each approximately five miles distant from the central power station. The current is transmitted to them by three-core cables, each core having a sectional area of 0·05 sq. in. In each building is provided a rotary converter room and a transformer room. The equipment, which was supplied by the Westinghouse Company, at present consists of two rotary converters and seven transformers, together with the necessary switchboards. The rotary converters have a full load rating of 250 KW., at 550 volts, and at a speed corresponding to 25 cycles per second. They are interchangeable, and are capable of over-compounding from 500 volts at no load to 550 volts at full load, and also of withstanding 50 per cent. overload without sparking and with the brushes in a fixed position, and 100 per cent. overload without surging or falling out of synchronism.

Each rotary has directly coupled to its shaft a 15-KW. booster, the magnet frame of the booster being carried on a bracket cast on the base of the rotary. These boosters are run as separately-excited generators, and arrangements are made to connect the fields in circuit with any one or more of the main feeders, whilst the armatures are connected in series with the return feeders, the further end of the feeder being connected to a distant point in the track. Each booster is provided with a field rheostat connected in shunt across the field. A small induction motor is provided for starting the converter.

The transformers are of the oil type, having a full load rating of 100 KW., with a secondary voltage of 330 volts and a frequency of 25 cycles per second. The impressed voltage on the high pressure side is 5,000 volts, and the corresponding secondary voltage may be either 310, 330 or 350 volts, three leads being brought out to a terminal block fixed on the transformer, and having a switch for connecting to any of the terminals. The transformers are grouped in sets of three, and are connected on the delta system, one being spare.

In each sub-station there are switchboards for the high pressure and low pressure currents. The high pressure board consists of five panels, there being two feeder panels and three transformer panels. The low pressure board consists of 13 panels—three rotary converter panels, two meter panels, two booster field panels, two booster armature panels, two traction feeder panels, one Board of Trade panel, and one spare panel. The booster field and armature panels, and also the traction feeder panels, are arranged as plug boards, and it is possible to plug either booster on any main feeder or return.

At each of the sub-stations there are commodious car sheds and offices, each car shed accommodating 50 cars. In each case pits are provided between the tracks for inspection purposes.

Rolling stock of a superior model has been specially designed for this system. The B.T.H. Company supplied the car equipments; Messrs. Hirst, Nelson & Co. and Milnes & Co. supplied the car bodies, while the trucks were supplied by Messrs. Blackwell & Co., and also by Messrs. Maguire & Co. Each car is mounted upon two four-wheeled bogie trucks, and is equipped with two 25-H.P. electro-motors, weighing 1,480 lbs. each, and each capable of exerting a horizontal effort of 1,270 lbs. on a 30 in. car wheel at a speed of eight miles per hour. There are seats for 69 passengers, 30 inside and 39 outside.

The controllers and other electrical apparatus on the cars are of the most advanced type, and electric light is provided for interior lights, as well as for the powerful head-lights recessed in the dashboard at each end of the car. The controllers are of the series-parallel type, embodying the magnetic blow-out principle. Electric braking is effected by the controller connecting the motors as series generators and in series with the same resistance as is used for starting the cars; and this resistance is gradually short circuited by the successive points on the brake side of the controller. The current required for braking is therefore derived from the motors acting as generators, and is altogether independent of the trolley wire. The brake-power thus at command, entirely apart from the ordinary brake-power on each car, gives to the conductor immediate and full control over his car, and from the public point of view is of great importance. An emergency stop can be effected, at any speed, much within the car's own length.

The cars have also been designed and constructed with every regard for the comfort and convenience of the travelling public. Handsomely fitted and luxuriously upholstered internally, they afford an admirable illustration of the most advanced form of public conveyance, while the seating outside consists of reversible benches designed in the most comfortable shape, and elegantly fitted in coloured woods.

In concluding this sketch of an important public work, which is constantly being extended, and has already involved a capital outlay of no less than £1,000,000 sterling, one remarkable feature remains to be noticed. This is that the whole of the work, structural, outdoor, architectural and technical, has been designed and carried out by the company and its staff, no outside aid being employed, nor has any contractor been engaged either for building or out-door construction. The engines and dynamos and other technical details were purchased from the manufacturers, on the specification, in each case, prepared by the company's engineers.

Mr. J. Clifton Robinson has acted throughout as engineer to the company, and the whole installation was carried out in accordance with specifications and drawings prepared by Mr. H. F. Parshall, consulting engineer to the company. We have to express our thanks to these gentlemen for the information embodied in the foregoing description of the undertaking.

CORRESPONDENCE.

Fly-wheel Design.

I was interested by an article on the above in a recent issue of your journal, and think that I can profitably make some remarks on the same.

I propose to treat the subject in the simplest manner, taking a three-crank single-acting "simple" engine and neglecting the effect of the obliquity of the connecting rod.

Draw a line, A B, making it equal to the stroke to any convenient scale. Divide up this line into any convenient number of parts by the ordinates as shown. At the position of the piston, corresponding to each ordinate, find the steam pressure on the piston (in a new design by calculation, or in testing an existing engine by the indicator). Multiply the total effective load on the piston by the "crank arm," and set off this quantity on the corresponding ordinates. Note.—By crank arm I mean the quantity obtained as the product of the crank throw × sin of angle enclosed by crank and line of stroke.

Connect the points so found and we have a curve which shows the variation of crank effort (or torque). It should

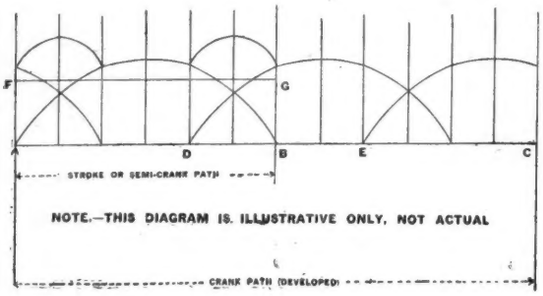
be noted that in the rough sketch diagram steam is supposed to be carried full stroke. If the expansion of the steam is taken into account which, of course, is necessary in an *actual* diagram, the character of the diagram will be materially different. The peculiar lumps would be smoothed off, for example.

Full treatment of the subject would, however, be too lengthy for this letter.

It is also obvious that the area of the figure also represents the work done per stroke = semi-revolution.

Produce line A B to C, making A C = twice the stroke, and divide into three parts by points D and E.

Now line A C is a development of the crank path, and points A, D and E are the points on the developed crank path, corresponding to the admission point of each crank.



It will be noticed that the turning moment diagram of crank E is not completed when it cuts the ordinate through C. This indicates that piston A has not completed its stroke before piston D is contributing to its turning effort. Therefore continue the plotting of crank diagram D from A.

We now have the complete diagram for one stroke of piston A = half revolution of engine. The complete turning moment diagram will obviously be the sum of all the diagrams at each ordinate, and the curve drawn through the points so found will be the desired diagram; the same diagram also represents the work done by the whole engine for one half revolution.

Now if the turning moment were uniform, *i.e.*, if both the driving force and crank-arm were uniform throughout the entire semi-revolution, as in a turbine, then the turning moment diagram would be represented by a rectangle A F G B, and in the case of our steam engine, would be equal in area to the figure of the turning moment diagram, the height being $\frac{\text{area of crank effort diagram}}{\text{length of stroke}}$.

It will be noticed during a part of the stroke the crank effort diagram rises above the diagram of uniform effort. During such periods the surplus work is being stored up in the fly-wheel.

The area of the space enclosed between A F G B and the curved figure represents the energy taken from the fly-wheel, and also marks a period during which the work done by the engine is not supplying energy sufficient for the average demand.

Therefore to design a fly-wheel to equalise the turning effort all that is necessary is to make a diagram similar to that in the sketch. On the same base (= one stroke) draw a rectangle of similar area, and by means of the planimeter or other method take out the areas of the parts between the curve of turning moment and straight line F G, and calculate the weight of rim such that with the contract limit of speed variation sufficient energy will be given off to equal the energy represented by these deficient areas, always remembering that the energy given off varies as the square of speed variation.

With a double-acting engine the turning effort diagram is necessarily more uniform, since there are six impulses per revolution instead of three.

Thus far I have only considered the fly-wheel as an equaliser with regard to turning moments. There is, however, another function which it has to perform, viz., that of a governor.

All governors have a time factor, that is to say, an interval of time—more or less considerable—elapses before the demand of the load for more or less steam is met by the governor, and during this period the difference of power has to be made up by the fly-wheel, by a falling off of speed for increased load, and by a gain in speed for reduced load.

To take an exaggerated example, suppose that in the case of a slow speed engine the load is suddenly removed just before steam admission. If the engine has a trip valve gear the steam is cut off, and it cannot be readmitted till the return stroke has commenced. If the engine is single-crank or two-crank compound, and runs at 100 revolutions per minute, this means that when driving a 100 ~ alternator the engine is deficient in power for half a phase,* and under such conditions trouble may be expected when running in parallel.

It is difficult to generalise on this point, but it is none the less necessary to take the class of governor and the character of the load into account when considering what weight of fly-wheel is required.

In the writer's experience and observation, troubles in parallel running of alternators may often be due to a sluggish governor and too light a fly-wheel, combined with a variable load, say one or more large theatres, and on light load. It is for this reason that the writer is a strong believer in spring governors, since they have a lower time factor, and in addition can be made to give a greater effort for the same speed variation, as compared with a governor of the Porter type.

The point as to greater available effort is of great importance when the governor has to move heavy gear with a great number of joints, the Sulzer gear for example.

The function of the fly-wheel regarded as a "governor" as distinguished from its function as a "torque regulator," is of more or less relative importance according as the turning moment of the engine is uniform or otherwise. In connection with a low-pressure water turbine for example, the function of the fly-wheel is purely that of a "governor," since the turbine gives a practically uniform torque, and on account of dangerous hydraulic shock the governor is necessarily sluggish in controlling the water supply.

Your correspondent does not seem to be aware of the fact that there is no necessity of going to America for apparatus to test the variation of the impulses since, an apparatus, known as the Moscrop speed recorder, has been in use in this country for many years.

It would be rather interesting if it could be ascertained for the different types of alternator—(*a*) coreless (*b*) iron-cored (magnet), (*c*) inductor—just what percentage variation from mean speed would cause difficulty in working in parallel.

Of course, if it can be made possible to synchronise the engines as well as the alternators, single-crank engines should answer as well as an engine having a more uniform turning moment, since the trouble is not caused by the varying impulses in a single engine, but by the variation between two or more engines.

It is further easy to see *why* a low ~ renders parallel running easier than with high ~, since the relative phase angles are less subject to alteration.

Geo. T. Pardoe.

July 27th, 1901.

The Hardships of Contractors.

For many months I have read with interest your "Current Specifications," and have noted your condemnation of the various methods adopted to so bind the contractor that he can have no resource against his employer or the latter's representative. Your criticisms have undoubtedly been just, and it is deplorable that some concerted action is not taken to prevent manifest wrong. All contractors appreciate the evil that exists, but practically none dare sacrifice immediate possibilities of business by taking a firm initiative. I doubt whether the time will ever come when there will not be someone ready to accept any contract, however extraordinary its provisions, and "run for luck" as to whether he will or will not come out ahead in the contest of wits that follows.

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* Apparently this ought to read "for 30 periods."—Eds. Elec. Rev.

An unjust specification, embodying terms of unreasonable severity—especially the denial of arbitration—is sure proof of a weak, ignorant, self-sufficient, or venal engineer. But too frequently several of these enviable qualities are combined. Consequently there are many chances from the point of view of the contractor whose principles are not unduly elevated that he may escape the terrors which the specification contains. There are many who will take the risk, and few who, if they did not take the risk to some extent, could continue in the contracting trade.

I have known cases where tenders were utterly rejected—unopened, in fact—because the offerers pointed out in their covering letters absolute impossibilities of construction. Other competitors have secured the orders, and at higher prices, and, being wise enough to call no attention to engineers' errors, were not interfered with when they substituted properly constructed material. Again and again I have seen the most amusing instances of the manner in which, by the exercise of "tact" (of the "Florodora" variety), the most noxious terms of a specification were practically shelved. The same qualities which induce the insertion of absurd precautions, render the proponent thereof most liable to circumvention.

The thing, however, to which I desire to call your attention, and to which I do not think you have referred, is where the usual extraordinary "conditions" now prevalent are intentionally and deliberately inserted and enforced with a view to their being utilised in full, to the contractor's damage and to the advantage of his employers. You can easily see that, in unscrupulous hands, clauses which give the "engineer" absolute power as to acceptance or rejection of workmanship and material, might be used to compass something closely approaching fraud.

The humour of such a case is that legal procedure is useless. To issue a writ against such a company is to give it all it wants, namely, sufficient time to complete its undertaking, and place its securities on the market in the first flush of successful operation. The "law's delays" make it certain that a couple of years will elapse before any final action can be obtained, to say nothing of the certainty that 90 out of 100 contractors will not take legal procedure until they have wasted six months or a year in unavailing attempts to satisfy any customer. In fact, they don't fully appreciate the game that is being played, in which they furnish the stakes for both parties, until they are hopelessly involved in the net. Furthermore, no contractor desires to take action when he knows that his material and methods of procedure will be venomously attacked and everything done to damage him to such an extent as to prevent others following his lead. Men who are playing the game of desperate promoters can too easily find high legal talent and witnesses with elastic consciences to support any line of action which may suit their purpose.

So much for the possibility of intentional duplicity. It might arise in any case, for no one can say what changes in ownership may take place in any company, or who may succeed any given engineer or manager. Unfortunately, the issuer of a specification refuses to take this view in nine cases out of ten, and considers any such suggestion as a personal affront.

Again and again I have known cases where a former assistant has become principal, and has taken out of the contractor everything which the specification might be stretched to permit, simply to demonstrate to his employers how much more acute he was than his former chief.

Local authorities are atrocious sinners in their relations with contractors.

The conditions of their specifications are confessedly so drawn as to preclude the possibility of a contractor having rights of any kind. The committees are usually composed of individuals who are wholly ignorant of the subject matter, puffed up with pride in their exalted position, and paralysed with fear of their constituents and their local press. If the engineer be a strong and intelligent man, he leads them by the nose and the contractor has a chance of fair play. If he be weak, young, and as miserably underpaid and inexperienced as many are, he is scared to death of his committee, and divides his time fairly evenly between bootlicking his principals and heckling his contractors. In most cases he makes capital with the former by imposing on the latter. I have had the distinguished honour of carrying out contracts for important and highly technical work under the immediate superintendence of a carpenter, a bricklayer, a railway gauger, and a local tailor, and I may assure you that no one of these individuals dreamed that the value of my opinion on any engineering point could approach that of their own.

Needless to say that such superintendence offers every opportunity of taking advantage of bumptious ignorance. Heaven help the contractor if such an individual, endowed with full power by a committee of such intelligence as to permit of his appointment, develops engineering theories, becomes an inventor, or who has friends who must be considered.

It all seems so ridiculous and so utterly squalid and unnecessary. What the cure may be, I do not know, nor have I the slightest idea of sacrificing my humble self by actively disseminating my views in person. One suggestion I would like to make, viz. :—That it would serve a most useful purpose if you would tabulate for the trade the amount of the several investments of each local body in machinery and its accessories, the name of the engineer in charge, his qualifications and experience, and the salary he receives. The opinion of the Presidents of the great Institutions as to what responsibility should attach to a given wage, would be well worth having, and might induce a much needed reform.

Anything to prevent contracts being let by favour, and that favour obtained by means which degrade the name both of engineer and contractor.

Anything to prevent such conditions being attached to specifications as to avoid the possibility of manufacturers and contractors being used as tools by clever and unscrupulous gamblers who would not hesitate an instant to attack and destroy the reputation of any individual or concern rather than let their schemes miscarry.

Anonymous.

Central Station Man's Grievance.

I notice in your last issue "An Enlightened Student's" remarks on the question of charge engineers for central station work.

I fear Mr. "Enlightened Student's" knowledge of men and matters is somewhat small, and of marine engineers practically *nil*.

Personally, I notice that central station engineers endeavour to run their works on business principles, not as philanthropic institutions for the sole benefit of budding Maxwells or embryo Faradays, and it stands to reason that a marine *fitter* who earned his £15 a month, all found, in that capacity would be engaged at 35s. a week in preference to a young inexperienced youth who has had no practical work.

Year by year the mechanical problem in central station work is becoming more and more important, and as far as charge engineers are concerned, it is easier to teach a good marine engineer the necessary electrical portion than a student everything, but I think that Mr. "Enlightened Student" will find that a very fair proportion of the genus "marine *fitter*" (which, by the way, is classed by the B.O.T. as a marine engineer) is not without some sound electrical knowledge, gained either at sea or at some technical institution. I quite agree with the warning he issues to his fellow-students, but the remedy lies, not in attempting to prevent marine engineers from obtaining these posts, but in students grounding themselves thoroughly in practical mechanical work as well as entering the various colleges, &c. Then, perhaps, will the electrical student be able to keep his profession in his own hands.

Collegiate-plus-Marine.

August 3rd, 1901.

In reply to "Enlightened Student" of the 2nd, he opens out the preliminaries of an argument, which, to receive its due, is certainly beyond my abilities to discuss fully. What do the duties of a "charge engineer" imply? Certainly, to the best of my knowledge, they don't embrace management and up-keep of mains, &c., outside the power station. The duties, therefore, resolve themselves to the manipulation, examination and repair (partially) of dynamos, balancers, batteries and switchboard arrangement and instruments, in the electrical department, and similarly to modern high

pressure steam engines, boilers and other steam plant auxiliaries often, including modern condensing plant and forced draught.

Now a "marine *fitter*" is no more a certificated marine "engineer" than the armature winder or commutator builder is a "charge engineer," and similarly a "marine fitter" uncertificated is unable legally to undertake a "marine engineer's" (certificated) position, any more than a "wireman" can take the position of "charge engineer."

A marine "engineer" takes all risks appertaining to management or mismanagement of plant under his charge.

Further, in a modern station, the steam plant is as expensive on first outlay as other parts of the station, and it is very much more important as regards keeping up efficiency and keeping down working expenditure, relatively to the electrical details.

I may venture to add that efficiency of electrical plant, which is high, may fluctuate 3 or 4 per cent., but a similar fluctuation per cent. of steam plant efficiency, the best of which is relatively low, may eventually cause a change of "charge engineer."

Being an old reader, I crave pardon for trespassing upon valuable space in your paper.

San Marino.

I have just read the letter written by an "Enlightened Student," and been much struck by the bitterness which he displays against what he calls marine fitters—by which he evidently means sea-going engineers. A sea-going engineer is undoubtedly a marine fitter, but the converse need not necessarily be true; certainly a marine fitter, as such, would not draw £15 per month unless he were a foreman in charge of a number of men.

But why should this type of man be totally unfitted to occupy the position of charge engineer in a central station? Isn't this rather a sweeping statement to make? In some of the larger stations the mechanical details of the works are of far greater importance and more complicated than the purely electrical, and if an "Enlightened Student" will only pause and think a little, will he not find that in the station, which he mentions as being in the North of England, the sea-going engineers only take charge of the boilers for some considerable time at the commencement, and do not take entire charge until they have fully grasped the fundamental principles of the electrical details and know what to do in ordinary cases of emergency, also that there are assistant engineers to look after the purely electrical part of the work, who do the switching, testing, &c.

A sea-going engineer is a mechanical engineer who not only has been through the shops and studied steam, but has had charge of heavy running machinery and boilers; whose past experience, one would think, well fitted him to be a charge engineer in a large station, whereas in a smaller station he would be of little use owing to having to take entire charge at once, and to the duties being more miscellaneous.

Every electrical engineer, properly so called, is a mechanical engineer, so why should a sea-going engineer, who is essentially a mechanical engineer, be refused admittance to the electrical profession, which is a branch of the mechanical? Most sea-going engineers have received good education and are fairly well armed with the necessary weapons for tackling the theory of electricity; the only difference worth noticing is that they enter rather late in life, and are therefore handicapped. If, on the other hand, they have not been so fortunate as to receive higher education, the probabilities are that they will not rise above engineers on watch.

Should not an electrical engineer student (*i.e.*, one going through a mechanical, technical and electrical training) rather than fear the advent of sea-going engineers into central stations, consider it a compliment that a man drawing £15 per month with all found is willing to give up all this for 35s. per week in order to join the ranks of the electrical engineers? or has he met with one or two cads on his travels and so condemns the whole?

W. E. Pritchard.

Replying to "An Enlightened Student," I should like to give my views in the matter.

My experience of the "younger members of the electrical profession" has been that a very large majority of them who are charge engineers would make very inferior switchmen, much less engineers.

Their mechanical training is practically *nil*, and when they emerge with *honours* from a college, they have never seen the inside of a boiler, and to pick up a shovel and show a fireman how to stoke is beyond them; to get into a boiler suit is too degrading, and the bursting of a gauge glass will blow most of them out of an engine room.

Our central stations are full up of men who cannot tell whether a set is running properly and efficiently or not; as long as it answers to the stop valve it must be right. I have been a charge engineer in two of the largest stations in the kingdom, and may be allowed to know something about it, and I consider that in the mechanical engineer you get invariably the better man.

J. D. A.

Purchase of Foreign Machinery.

The letter in your issue of the 26th ult. on the above subject signed "A Consulting Engineer," is such a remarkable example of pro-any-other-country-but-your-own-ism (bolstered up with bad logic) and of the extent a man will allow the hatred of his own country and countrymen to carry him, that one can scarcely refrain from calling attention to it.

Your correspondent says, "Finally I was induced to look into foreign machinery, and have been very well satisfied therewith ever since." Really, if this wonderful machinery could speak it might say with Cæsar, *Veni, vidi, vici.*

Further, he tells us that the design of this machinery is "faultless;" then I would ask, Why are we told (and implored to do likewise) that the American designer designs his plant entirely with a view to its early consignment to the scrap heap?

Next, your correspondent cites several cases of failure of British dynamos through faultily designed electro-magnets, and although he neither gives his standard of comparison, nor the specification which the machines were supposed to fulfil, he draws (by insinuation) a wholesale conclusion as to the calibre of British designers.

Having demolished the designer, he seeks to prove the British manufacturer to be a *fool*, by quoting an advertisement which on the face of it is a hoax; these unfortunates being cleared out of the way, your correspondent seeks to clear himself and his clients of responsibility by a mere dictum.

After citing further cases (all with the same absence of detail) of British "idiocy," he concludes by stating "that there are deeper reasons at the bottom of the purchase of foreign machinery than appears on the surface. . . . . It will take more than quick delivery and good workmanship to induce me to advise the purchase of machinery made at present in Britain for heavy engineering work," and with these two statements I cordially agree, particularly the last one.

Really, Sir, one would hardly credit that an educated man, such as your correspondent presumably is, could write such a mass of contradictions, mis-statements, and vile insinuation; he has the assurance to say that our best firms can neither design nor make an ordinary dynamo field, that "faultless workmanship" and "mechanically unsurpassable for durability" are features of secondary importance. Unfortunately (like our pro-Boers), the enumeration of contrary facts would be like pouring water on a duck's back, and I will, therefore, not attempt it, but will conclude by quoting one or two extracts from a letter written by Mr. C. T. Yerkes to the *Times* of July 31st, in the rather forlorn hope that they will correct your correspondent's ideas as to the importance of durability, and also as to the "faultlessness" of American designs.

First as to "faultlessness."

Mr. Yerkes writes, "I will say we have never been afraid of the scrap heap whenever *we found we had made a mistake, but we do not court it.*" "*It is full of wrecks of failures.*" (The italics are mine.)

Again, as to "durability."

Mr. Yerkes, speaking of the system to be adopted on the Metropolitan, says, "To take a system which has not been

thoroughly tested, not for a few but for many months and even years, is a species of business recklessness which I do not wish to try."

Further comment is needless.

Fairplay.

The letter *re* "Purchase of Foreign Machinery" by your correspondent, "A Consulting Engineer," will surprise no one who realises that what may be termed "Industrial Pro-Boerism" is a factor to be taken into account in any survey of the situation. There is a type of buyer engineer, who, in obedience to some perverted instinct, is for ever depreciating the goods of his own country in terms of the most malignant spite, whilst he draws upon his ample store of fulsome adulation for unmeasured praise of the beloved alien.

With a great deal of "A Consulting Engineer's" criticism I am inclined to agree, but the true spirit of his remarks is condensed in his last paragraph: "It will take more than quick delivery and good workmanship to induce me to advise the purchase of machinery made as at present in Britain." In other words, no British need apply. No doubt "A Consulting Engineer" considers himself a very Brutus, and accounts it a very fine thing to fling mud at the industry on which he supports his valuable existence. His comparisons between American and British dynamos would be more interesting if his competence to judge were more clearly shown. As a rule, I have found that those who most loudly complain of British-made machinery are those whose transcendental abilities have not been recognised as widely as they should. They love the quiet paths of established practice, and yet prate loudly of the British manufacturer's disinclination to move. How American manufacturers must have smiled at the raptures bestowed on the obsolete traction stock which was thrown upon the English market a year ago at less than cost price, and which has furnished the padding for the fussy specifications which have since issued from time to time!

In a manufacturing nation like ours the interests of buyer and seller are practically one, and the engineer who advises his client to place an order with a foreign firm on account of a small advantage in either price or delivery is inflicting an injury upon the community at large, which eventually will be shared by his employers, and, it is to be hoped, in even a greater degree by himself.

Pro Patria.

Standard Railway Traction.

I have read the article in your edition of July 26th called "Standard Railway Traction," which is one of the most sensible things I have seen in print for some time, and I heartily congratulate the writer. He evidently knows what he is talking about—which is a rare thing in England where writers are dealing with electricity or electrical construction.

Chas. T. Yerkes.

Hotel Cecil, London,
August 3rd, 1901.

[The latter part of Mr. Yerkes's letter is a slight upon our technical press, which acknowledges no superior—certainly not in the U.S.A.—Eds. Elec. Rev.]

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"Brush" writes:—"Would you be good enough to inform us whether there is a more complete book of the Board of Trade regulations than that which is marked 2 C.—P., 1882 and 1888? Our case is this. We have just completed an installation to be connected to company's mains. They inform us that they will supply us in a few weeks with 230 volts. As they commenced working under a provisional order last March, cannot they be compelled to supply us with 115 volts, as their mains at this pressure are now past the premises?"

*** It is difficult to answer the question put by "Brush" without having reference to the terms of the provisional order under which the company in question have power to supply electricity for lighting purposes. We presume, however, that the installation which our correspondent's firm has just erected is adapted for the receipt of current at a pressure of 115 volts, whereas the company are seeking, probably with a view to more economical working, to raise the pressure of supply to 230. We are not aware of any regulations recently published which bear upon this question, except that, as a result of the inquiry held by the Board of Trade this year under the presidency of the late Sir Courtenay Boyle, the older regulations underwent some slight modification. Thus, by Clause 5 of the older regulations, it was provided that the standard pressure shall be fixed by the undertakers, and that notice of the amount of such standard pressure shall be given to the local authority before the undertakers commence to supply energy to the consumers, and further, that such standard pressure shall not be altered *except by permission of the local authority, and upon such terms and conditions as the local authority may impose.* By Sec. B. (6) it was further declared that "the pressure so declared at any consumer's terminals shall not at any time be altered or departed from except in consequence of some authorised alteration of the corresponding standard pressure." Finding that these regulations were too stringent, and that the provisions which gave consumers the right to object to a change of pressure were too hard upon the companies, the Board of Trade this year, after the inquiry already mentioned, have made a new regulation whereby, if the company defray the expense of making the change, a consumer may be compelled to take a supply of current at the increased pressure or not at all. We are not aware that our correspondent will be affected by these provisions; but if he has already provided for the receipt of current at a lower pressure, it is only just that the company should defray some portion of the expense which must be incurred to enable him to receive the current at a higher pressure.

LEGAL.

Chamberlain & Hookham *v.* the Mayor and Corporation of Huddersfield.

In the Chancery Division on Saturday, before Mr. Justice Kekewich, Mr. Walter appeared in support of a summons asking for leave to discontinue the action. The plaintiffs were registered owners of letters patent for improvements in electrical meters, and an injunction was claimed against the defendants for infringement and for other relief. The defendants had denied infringement, and also pleaded invalidity.

Mr. Walter having stated the nature of the application,

Mr. Justice Kekewich asked why the action should not be discontinued?

Mr. Walter said he did not know, but he believed his learned friend, Mr. Terrell, had certain objections to urge.

Mr. Terrell said what he was going to ask for was that no other action should be brought in respect of the same infringement; next, he submitted they should have the costs as between solicitor and client; and thirdly, that they should have the costs of the particulars of objections as if they had been certified as proper and reasonable.

Mr. Justice Kekewich said he should do that subject to what Mr. Walter might say. If Mr. Walter made any objection, he should expect the particulars of objections to be justified.

Mr. Terrell said he took about a week to settle them, and he did not know how long it would take to justify them. They were very carefully made, and everything was excised that could be excised. With regard to his point that the plaintiffs should be put upon the terms of not being allowed to bring any other action with respect of the same infringement, he might say that the makers of these meters were the Westinghouse Company, and they were bearing the costs of these proceedings. They were indemnifying their customers, among whom were the Corporation of Huddersfield, and it would be very hard if, after having been put to all the expense necessitated by this action, another action should be commenced against another customer, then discontinued, and another action brought, and so on. In these cases an indemnity by the manufacturer to the customer was customary. They were driven to that, or they would have no customers.

Mr. Walter said he did not know of a single case with which the Dunlop or Welsbach Company had given an indemnity.

Mr. Terrell was afraid his learned friend's memory was not quite so good as it used to be. What his learned friend was trying to do by the present proceedings was to get a judgment covering an alternating meter when the alternating meter was not there to protect itself, and he submitted the Court ought not to help him to do that. The defendants were prepared to go to trial, and now his friend wanted to discontinue simply on the terms of paying the costs, when they would be at liberty to begin again.

Mr. Justice Kekewich: Against somebody else.

Mr. Terrell: Perhaps; but really against the Westinghouse Company, because they will have to pay the costs. The defendants had been put to enormous expense in preparing for trial, and they were ready to go on. He did not mind admitting that they were trying to force the plaintiffs to go on.

Mr. Justice Kekewich: You are tempting me to try and get rid of the action.

Mr. Walter, for the plaintiffs, said his friend was quite correct in stating why the plaintiffs desired to discontinue the present action.

It was not because they did not want to take proceedings against the defendants, but because there was an important action pending in the Court of Appeal with which the interpretation which had been put upon the plaintiffs' specification by Mr. Justice Farwell would be submitted for review. No doubt the plaintiffs desired that the decision on that matter should be obtained before the costs of the present trial were ascertained. It was not that they did not desire to test the infringement in this case, but simply that they might be enabled to follow the judgment of the Court of Appeal.

Mr. Justice KEKEWICH: According to your view, if you succeed in the Court of Appeal, then you will be right in this case, will you not?

Mr. WALTER said that was the view taken by the plaintiffs. With regard to the solicitor and client costs, he submitted his learned friend was not entitled to them, this being an interlocutory application. As to the question whether the plaintiffs were to be at liberty to bring another action against the defendants, he submitted the plaintiffs ought not to be put upon terms. This was a continuing infringement, and, presuming the defendants were going to continue to infringe, there was absolutely no authority for a Court holding that no further proceedings should be taken. He was willing that no further proceedings should be taken against the Huddersfield Corporation in respect of past infringements, but his friend was trying to prevent them taking action for all time and against persons who were not before the Court at all.

Mr. TERRELL pointed out that the first and principal patent had expired.

Mr. WALTER said there were two other patents. He should ask his Lordship to say that the defendants should have general costs of the action, and that they should, if his Lordship so determined, have the costs of the particulars of objection, but that no other terms should be imposed upon the plaintiffs.

Mr. Justice KEKEWICH, in giving judgment, said this was an application by the plaintiffs in a patent action for leave to discontinue, and it was entirely within his discretion to give or refuse leave, and if he gave it to impose such terms as he thought fit. Mr. Terrell had asked him to impose three terms, and as to the first two that he should be allowed solicitor and client costs, and should have the costs of the particulars of objections, he thought he ought to impose those terms. The third point raised questions of more difficulty. It was said that he ought to impose upon the plaintiffs the burden of not bringing any other action in respect of the same meter. If he had limited his request to any other action against the present defendants he should have had no hesitation in imposing such a term. Now, stated boldly in the way Mr. Terrell had stated it, he thought there was a complete answer to his argument in that the defendants had nothing to do with any other infringement, and they could use their meter so long as they pleased. But he was told, and it was uncontradicted, that the manufacturers of the meter were the Westinghouse Company, and that they had indemnified the present defendants, and were bound to indemnify other customers. Therefore, he was really being asked to say that no other action should be brought against the Westinghouse Company or other persons who dealt with them. The immediate reason why this action should be discontinued was, that there was an appeal pending at the present moment from the decision of Mr. Justice Farwell, who had held that the patent had not been infringed, and of course if Mr. Justice Farwell's judgment stood they would hear no more of any actions of this kind.

Mr. TERRELL: I don't think my learned friend will say that.

Mr. Justice KEKEWICH: But in the meantime the plaintiffs were unwilling to bring this action on for trial. Under the circumstances, he did not consider it fair to impose upon the plaintiffs the terms of not bringing any action against any other persons who might deal with the Westinghouse Company, where in the present case the contest was nominally only between the plaintiffs and defendants. What he should do would be to give leave to the plaintiffs to discontinue the action on the terms that they paid the defendants' solicitor and client costs, the costs of the particulars of objections, and that they undertook not to bring any other action against the present defendants with respect of the infringement alleged in the proceedings.

Mr. WALTER said he was willing not to bring any other action against the defendants in respect of infringement up to the date of the writ, but as to not bringing actions for continuing infringement, he was afraid he could not give an undertaking without first consulting his clients.

Mr. Justice KEKEWICH said he would give plaintiffs a week to consider the matter. If they did not agree to the conditions imposed the application to discontinue would be refused, with defendants' costs in any event.

WRIGLEY *v.* THE WINDERMERE AND DISTRICT ELECTRIC SUPPLY COMPANY.

IN the Chancery Division on 26th ult. before Mr. Justice Kekewich, Mr. Laurence, K.C., who appeared for the defendants in this case, applied that the hearing of this action, which had been fixed for Tuesday next, might be postponed. The plaintiff sought to obtain an injunction to restrain an alleged nuisance by noise, vibration and smoke. With the consent of both parties, Mr. Cartwright had been sent down to Windermere to make an independent report on the matter, and that report had now been received. Learned counsel said that Mr. Cartwright had come to the conclusion that there was some nuisance by noise, vibration, and possibly by smoke, and under these circumstances he thought it would be desirable for the parties to put their heads together and see what could be done, as the trial would be a lengthy one, because the defendants proposed to raise the question of prescriptive right. There was a mill on the site of the defendants' works which had been going on for over 50 years, and the electricity works had been in operation for six years.

Mr. WARRINGTON, K.C., who appeared for the plaintiff, said the works had been going on, perhaps, but not all the time with the present machinery. The machinery had been largely augmented. He should submit that the trial ought not to be postponed. With regard to what had been said about the mill, it was a bobbin mill, and was driven by water power alone.

Mr. LAURENCE: And made as much noise and vibration as our machinery is said to do now?

Mr. WARRINGTON said that was a point not dealt with by Mr. Cartwright's affidavit.

Mr. Justice KEKEWICH said he did not think there ought to be a trial on Tuesday on the present materials, because possibly they would only arrive at the conclusion set out in Mr. Cartwright's report.

Mr. WARRINGTON said Mr. Cartwright had made several suggestions as to what could be done to mitigate the nuisance. He had suggested the adoption of a continuous current supply, the use of steam turbines, and the deadening of the noise by double windows. He submitted that he ought to be put into such a position as if the nuisance was admitted.

Mr. Justice KEKEWICH: What do you suggest ought to be done?

Mr. WARRINGTON said that supposing the action came on for trial and succeeded, either his Lordship would grant an injunction and suspend it for a limited time in order to enable the company to remedy the existing state of things, or would express an opinion that there was a nuisance and give liberty to apply for an injunction, which would amount to the same thing.

Mr. Justice KEKEWICH doubted whether the defendants could do anything.

Mr. WARRINGTON suggested that his learned friend should make an admission which would obviate the necessity of the plaintiff having to prove nuisance, and then the orders might stand over until the next sittings, leaving the question of prescription to stand over. Then in the meantime the defendants might find some way of mitigating the nuisance.

Mr. LAURENCE said he should not attempt to disprove the report, but he was not prepared to make the admission asked for until he had an opportunity of consulting his clients. Supposing the defendants had to stop their works altogether, the effect would be most serious to a very large number of people, and the company would incur heavy penalties under the Act of Parliament.

Mr. Justice KEKEWICH said he did not see how he could consider the defendants, but he was bound to consider the public.

In the result his Lordship directed that the action should be on the paper for trial on Tuesday.

The case came before Mr. Justice Kekewich in the Chancery Division last week.

Mr. P. OGDEN LAURENCE, K.C., who represented the defendants, said that the character of the report rendered it absolutely necessary that the defendants should very carefully consider their position. He was prepared to make an admission on the defendants' behalf, on the strength of Mr. Cartwright's report, that the works of the defendants, as at present conducted, did create a nuisance by smoke. He thought, under these circumstances, that his learned friends on the other side would agree to the matter standing over till next sittings, when he would be in a position, on behalf of the defendants, to raise the question of prescription.

Mr. WARRINGTON, K.C., for the plaintiffs, said that he was entitled to have the question of prescription determined at once.

Mr. LAURENCE pointed out that the case must be tried as a whole.

After some discussion it was arranged, on the defendants agreeing that there was a nuisance caused by smoke, and that they would pay the costs in any event of that day's proceedings, that the trial of the action should be set down for November 5th, subject to anything part heard.

AMBLER *v.* BRADFORD CORPORATION.

MR. JUSTICE JOYCE, in the Chancery Division on Saturday, 3rd inst., delivered judgment in the case of Ambler & Sons, Limited, *v.* the Mayor and Corporation of Bradford. We reported the case briefly last week.

His LORDSHIP, in giving judgment, after stating the facts, said it was somewhat remarkable that there was not any evidence adduced on behalf of the plaintiffs with respect to the condition or capacity of the waterway where the sluices were erected before the alterations made by the Corporation. It might be that those alterations, instead of obstructing, really facilitated the passing away of the water below Lionel Street bridge; and, indeed, the only evidence on the subject, though by no means satisfactory, was that such was the fact, viz., that the works of the Corporation, having regard to the previous condition of things, were no obstruction at all, in which case the plaintiffs, as it appeared to his Lordship, would have no grounds for the institution of the present action. The real question he had to decide was whether the sluices or sluice gates, although raised to the top on the occasion of the flood of July, 1900, caused any obstruction to the flow of water as high up as the plaintiffs' premises, and indirectly occasioned the bursting up of the floor of their buildings erected over the stream and the flooding of their adjacent field. The question was undoubtedly a difficult one to an ordinary person not possessed of special knowledge or versed in the science of hydraulic engineering. There was a direct

and complete conflict of evidence upon the subject. His Lordship then examined the scientific evidence given at the trial, and said that the view of the defendants' scientific witnesses that the sluices were in no way responsible for what happened in the plaintiffs' premises accorded with the conclusion produced in his own mind, unfurnished with any special scientific knowledge. The result was that the evidence failed to convince his Lordship that the construction or existence of the sluices complained of caused any damage to the plaintiffs' premises, or in any way affected within the plaintiffs' premises the behaviour or effect of the flood, which came down from above and found itself restricted to the channel which the plaintiffs had made by the erection of buildings upon or over the course of the bank at that point. He therefore dismissed the action.

Order accordingly.

The Liverpool Mortgage Insurance Company, Limited, *v.* The British Electric Works Company, Limited.

In the Chancery Division of the High Court of Justice on Saturday, August 3rd, Mr. Justice Cozens-Hardy had before him a summons for further consideration of this Liverpool District Registry action by which Mr. R. F. Hall, the late general manager of the defendant company, asked that he might be paid £1,200, being 2 per cent. of the price at which the defendant company was sold. The defendants, who carried on business at Birmingham, contended that the sum was too high. It was stated that Mr. Hall was a director in addition to being general manager, but that he resigned his position as director before the arrangement for a commission on the sale was entered into. The letter written by Mr. Hall resigning his position was not produced, and counsel for the liquidator stated that he had never seen it.

Mr. Justice Cozens-Hardy said he could not deal with the claim until he had seen the letter. The summons must stand over until next sittings, and the company must pay £1,250 into Court to answer the claim and costs. His Lordship also had a further consideration of the action before him. The judgment in the action was pronounced on June 22nd last in the ordinary form, and the receiver and manager was authorised to act until the 10th inst., that being a date subsequent to the day when it was contemplated that the sale of the company's business should be carried through. The sale had been completed on the previous day, and there was now in Court a sum sufficient to pay all the incumbrances in full and leave a balance for the company. He discharged the receiver subject to the adjustment of various matters between him and the purchasing company.

THE GENERATION AND TRANSMISSION OF ELECTRIC ENERGY AT AND FROM COAL PIT CENTRES.

By B. H. THWAITE, C.E.

(*Continued from page* 136.)

One of the applications of the alternating system, *e.g.*, that for arc lighting, has already in a considerable measure succeeded.*

This arc lighting alternating application, however, involves careful supervision, but the cost of such supervision, owing to the convenient method of orally determining the efficiency of any arc, is almost negligible—and it is quite possible that in the near future we shall be able to avoid altogether the use of current transformers, and apply the alternating current direct to the arc lights and for other purposes.

Ordinary rotating transformers having a single field and armature, are not so efficient, nor do they possess the same qualities of high regulation as are possessed by the Schuckert special design.

The trend of electro-technical science is in the direction of rotary transformers, and especially for railway work; the latest development actually includes the location of the transformer in the railway vehicle or wagon itself, so that the transformation is directly effected.

In no instance is the excess of power capacity over the maximum requirements a greater qualification, than in transformer practice; therefore, let *ample capacity* of transformer equipment be considered as a *sine quâ non*.

Pressure Transformers.—The static type of transformer has been brought to a high state of perfection, and no hesitation may be felt in determining on the advisability of adopting electric transmission methods, because of the need at the terminal end of a regular output, and at low voltages.

The losses in well-designed and satisfactorily constructed transformers are now reduced to those included in the following schedule:—

1. Those due to resistance of the copper. These losses will be lessened by the provision of adequate transformer capacity.

2. The waste of electrical energy through the influence of molecular frictional resistance to the electric flow—called hysteresis—is equal in magnitude at all loads, the cause of this phenomenon is traceable to the effect of alternate reversals of magnetisation in the iron core. This source of waste of energy is reduced to the minimum by the employment of the very best possible character of iron, and maintaining the iron in a low state of magnetisation.

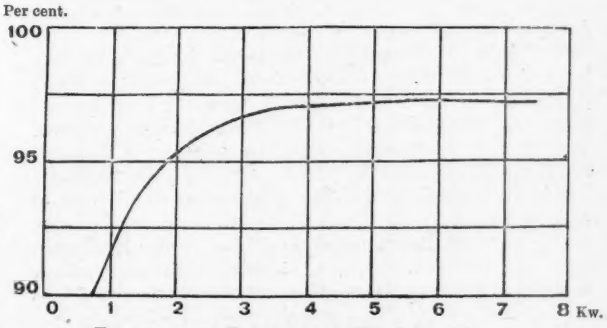
3. The eddy current losses. These sources of energy losses can be kept very low by the careful lamination of the core traversing the natural direction of the eddy currents. It is found in practice that the losses defined in category 1 and 2 are generally, in their effect, about equal in magnitude.

The maintenance of the transformer at a low temperature is an essential requirement if efficient and regular output is desired. The usual remedy is to provide air cooling spaces between the bunches of laminæ that structurally constitute the core.

In large transformers the cooling effect of an air blast is taken advantage of, to keep down the temperature of the core and the coils.

In blast furnace power installations, the immense supply of air under pressure produced by the large blast engines permits an ample supply of air to be obtained for cooling the step-up transformers and generating machines, but the employment of an inductive motor for supplying all the air required to keep down the temperature of a bank of transformers is the obvious alternative.

The placing of the transformers in banks is adopted in well-designed power stations. Transformers should, like gas engines and alternators, wherever possible, be worked *nearly up to their full capacity*, hence the advisability of dividing the transformer equipment into several units, so that they can be worked at nearly their maximum capacity. Nevertheless, a transformer varies very little in its efficiency in proportion to its per cent. of maximum load.



Efficiency of Transformer (Static) at Various Loads. Full Output 7·5 kw.

A transformer of 100 kw. output capacity, should be capable in sustained work of returning the full power fed into it with only a loss of 2 per cent.; if only half the full power is introduced, the loss will be 3 per cent., and even 4 per cent. Any high-class transformer above 50 kw. should be able to give a full load return of 98 per cent., with a lessened output of only 1 per cent. at half-load.

The diagram above shows graphically the efficiency curve of a well designed static transformer of 7·5 kw. output capacity.

In well-thought-out and rationally-devised and well-constructed transformer stations, the transformation losses should never be allowed to exceed a maximum of 2½ per cent.

The following are some of the characteristic features of modern European and American transformer practice:—

European.—The iron core is made to serve for several phase windings, two or more phases being transformed in a single apparatus. Composite transforming apparatus is in common use.

American.—Ordinary standard transformers single phase type in general use. Small power unit transformers are

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* Arc light alternating circuits at 5,000 volts line pressure, and in lengths of transmission of 20 to 40 miles, are not uncommon.

as the trial would be a lengthy one, because the defendants

or versed in the science of hydraulic engineering. There was a direct

cooled with heavy mineral oil. The arrangement of circulating the oil is well thought out, so that the oil rapidly effects the removal of the heat developed in the core and its surrounding coils.

All transformer foundations should be constructed with scrupulous care. The immense pressure required for high pressure transformer work makes the ground insulation a work of very serious importance. Porcelain blocks bedded on a floor of well-creosoted wood may be considered to constitute a desirable medium, for dividing the transformer from its concrete or masonry foundation.

Every transformer unit should be equipped with its own cut-out switch. A generous allowance of floor space should be allotted for transformers, so that the different units can be placed at a considerable distance apart.

Each transformer should be boldly placarded as being decidedly dangerous. High pressure leads should be located in full sight of the electrical staff; they can be insulated in tubes of porcelain or vulcanite.

All isolated transformer stations should have a repairing annexe, containing all necessary stores and tools requisite for rapidly and efficiently effecting repairs in the transformation apparatus and the associated service line.

It is well to bear this fact in mind, *e.g.*, that 500-volt pressure is deadly, and all pressures above this are only *more* deadly—if such a phrase is allowable. The same kind of danger to life objection was raised against the locomotive, when first introduced; it is still deadly, and people are not prone to stand in its way.

Switchboard Arrangements.—Switchboard arrangements for high voltage transmission projects occupy quite a different category from those of a low pressure ordinary lighting character. The immense electrical potential makes the precautions necessary to prevent the sparking across gaps of exceptional width, of serious importance. The switches should be placed at a considerable distance apart, and they may be screened off from each other with glass or porcelain screens.

The cut-outs should be magnetic, and not of the fuse character. All the safety apparatus should be applied to the lowest pressure end of the line; the application of the safety apparatus to the elevated pressure portion is liable to be associated with great danger to some one, and safety devices can be of little possible useful service applied to the generating end of the line.

The dials of the testing instruments should be of very large size and plainly readable at a considerable distance. Automatic pressure and capacity recording instruments should be provided and placed in conspicuous positions. Day by day observations should be permanently recorded for comparison.

Line.—Pessimistic theorists prognosticated all sorts of evils when the proposal was suggested to transmit electric energy at even line pressures of 15,000 volts; fatal accidents, the effects of resonance, inductance, short circuiting, dielectric influences, interference with the harmony of the three-phase currents, &c., were foretold. Fortunately, and once again, the difficulties prognosticated have not proved to be of sufficient magnitude to seriously reduce the great advantages of high pressure methods of energy transmission over long distances, and line pressures of even 40,000 volts are now in everyday use.

When trunk steam locomotive railways were first proposed, the prophets of evil imagined the daily prevalence of accidents all along the line. These prophets only live in the memory as examples of the genus "Croaker."

Unfortunately, the influence of the Croaker in these days of fierce industrial competition may prove of serious national disadvantage. In the future, too much of the precautionary brake on the wheels of progress may very possibly handicap us in the race for industrial supremacy.

It has been suggested that the aerial high pressure transmission of electric energy will not be permitted in this country. If this is true, it will most seriously retard the progress of long-distance transmission. No rational objection can be suggested of sufficient weight, to counterbalance the advantages of long-distance aerial and always-in-sight methods of electric transmission, compared with underground and out-of-sight methods.

The placing of high pressure cables in the ground, except infinite insulating care is applied, will involve possible losses of energy of so serious a proportion as to tend to destroy the economic advantages of this system of transmitting power.* One can hardly imagine the extent of the dangers that may be produced as the effect of a disruptive charge of the exposed end of an underground cable.

Further, the subterraneous water, existing as the means provided by nature for absorbing atmospheric electricity, is the wrong kind of environment for a high tension cable, which cannot be properly and permanently insulated with any form of insulator so far proposed. Possibly this difficulty of insulation may be overcome; let us hope so.

It will be realised from a glance at the tabulated list already presented of some of the long-distance installations in daily use, that the increase in the line pressures has been most remarkable.

(To be continued.)

BUSINESS NOTES.

Electrical Wares Exported.

Week Ending Aug. 7th, 1900.		Week ending Aug. 6th, 1901.	
Adelaide	Value £273	Adelaide	Value £153
Alexandria Teleg. mat.	138	„ Teleg. wire	220
Amsterdam	30	Alexandria	37
Auckland	1,596	Amsterdam	60
Azores Teleg. apparatus	2,382	Bangkok	86
Bangkok	42	Beira. Teleg. mat.	66
Bombay	70	Bombay	122
Brisbane	950	Buenos Ayres	87
Buenos Ayres	255	„ Teleg. wire	236
„ Teleg. mat.	225	Calcutta	153
Calcutta	336	„ Teleg. wire	100
Cape Town	543	Cape Town	1,081
„ Teleg. apparatus	200	„ Teleg. mat.	332
Colombo	37	Chinde	25
Durban	373	Christiania. Teleg. wire	41
East London	137	Colombo	133
Fremantle	125	Copenhagen	3,158
Georgetown	150	„ Teleg. cable	509
Hiogo	15	Durban	208
Hobart	150	East London. Teleg. mat.	2,618
Lyttleton	50	Gibraltar	19
Melbourne	870	Gothenburg	80
Nagasaki	92	Halifax	474
Nelson	297	Hamburg	83
New York. Teleg. cable	500,375	Hong Kong	30
Parana	2,014	Kobe. Teleg. cable	4,356
Perth	161	Labuan. Teleg. mat.	22
Port Elizabeth	150	Madras	17
Rotterdam. Teleg. mat.	180	Malaga	31
Shanghai	63	Melbourne	800
„ Teleg. wire (old)	150	„ Teleg. mat.	464
Singapore	85	Moji	50
„ Teleg. mat.	129	Montreal. Teleg. cable	48
Sydney (N.S.W.)	743	Nagasaki	377
Sydney (Cape Breton). Submarine cable	468	Ostend	55
Wellington	2,062	Penang	60
„ Teleg. mat.	1,831	„ Teleg. cable	397
Yokohama	444	Port Elizabeth	329
		Quebec. Teleg. cable	3,801
		Rio Janeiro. Teleg. mat.	15
		Santander	31
		Shanghai	120
		Stockholm. Teleg. wire	244
		„ Teleph. cable	620
		Sydney	486
		„ Teleg. wire	375
		Yokohama	3,518
Total	£518,195	Total	£25,883

Foreign Goods Transhipped.

Antwerp. Elect. apparatus Value £60

Annual Outings.—The London staff of Messrs. Veritys, Limited, took their annual outing on July 27th. Special saloons were attached to the 9 o'clock Brighton express from Victoria. Dinner was served at the Old Ship Hotel, Brighton, presided over by the London Manager, Mr. C. S. Northcote.

The employés of the lamp works of the Sir Hiram Maxim Electrical and Engineering Company, Limited, had their annual excursion on Thursday last week. The party, numbering over 100, accompanied by Mr. A. W. Hill (works manager), and Mr. E. J. Sander (late works manager), and several members of the staff, travelled from Liverpool Street to Clacton.

Electricity for Mines Drainage.—In the report of Mr. E. Howe (general manager), to the South Staffordshire Mines Drainage Commissioners, he points out that it will be necessary to adopt some more economical way of dealing with the water at Blakeley Wood than by tanking, and he suggests the adoption of electrical power, which can be obtained from the Midland Corporation for Electrical Power Distribution, whose works are in the neighbourhood, and in a most suitable position to start electrical deep mine pumping.

* At St. Croix, Wisconsin, there has recently been installed a three-phase underground conductor for a length of three miles, at a line pressure of 25,000 volts. The history of this interesting application will be of great value.

* Arc light alternating circuits at 5,000 volts line pressure, and in lengths of transmission of 20 to 40 miles, are not uncommon.

American.—Ordinary standard transformers single phase type in general use. Small power unit transformers are

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Auction Sale.—Messrs. Huddleston will, on August 13th, offer for sale a 6-H.P. Tangye gas engine and a Johnson and Phillips shunt-wound dynamo, also battery, instruments, fittings, &c., at the Victoria Hotel, Kilburn. See our advertisement pages to-day.

Books Received.—"Theoretical Elements of Electrical Engineering," by C. P. Steinmetz. New York: *Electrical World and Engineer*. $2.50.

"Universal Directory of Railway Officials, 1901." Compiled under the direction of S. R. Blundstone. London: The Directory Publishing Company, Limited. 10s.

"John Grant & Son's Directory of the British, Anglo-Argentine and North American Residents in the Argentine Republic, and Argentine Commercial Guide for 1901." Buenos Ayres: John Grant and Son, London: J. Samson, 5s.

A course of six lectures (with discussions) on "The Management of Engineering Workshops," by Arthur H. Barker, B.Sc. London: Institution of Junior Engineers. 3s.

"Original Papers by the late John Hopkinson." Two vols. Edited by B. Hopkinson. Cambridge: The University Press. 10s. 6d. each, net.

Catalogues and Lists.—Messrs. Thomas Parker, Ltd., send us a copy of the fourth edition (July, 1901) of their pocket list of continuous current dynamos, motors, &c.. General specification details, prices, and a few illustrations are given of Parker's plant in this handy-sized booklet.

An exceedingly neat volume has been brought out by the Sunderland Forge and Engineering Company, in which we find photographs of the interior of the different departments at the Pallion Works, Sunderland. Some excellent process illustrations of Pallion generators and motors are included. It certainly cannot be complained that the material is crowded into too small a compass, as is sometimes the case, for alternate pages are devoted exclusively to the illustrations, a few lines of letterpress occupying the centre of each facing page. Ship-lighting plant, central station steam-driven sets, and motor-driven shipyard machines, punching and shearing machines, joggling machines, woodworking tools, winches, pumps and cranes are all well shown.

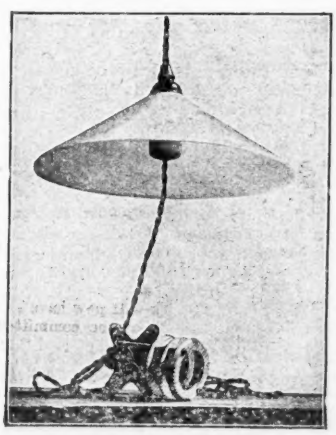
The Tandem Smelting Syndicate has issued a circular relating to its all-white anti-friction metals.

Messrs. Wm. McGeoch & Co., Limited, of Charing Cross Road, have just published some new lists for the trade showing their "A B," H V main switches, motor starting switches, and improved H V keyholders.

The B.T.H. Co. have brought out the following new pamphlets to be added to their collection:—No. 103, a summary of electric power contracts recently carried out or in course of construction by the company; No. 104, polyphase induction motors; No. 105, electric hoisting and haulage machinery.

The Lancashire Dynamo and Motor Company, Limited, of Trafford Park, have issued a new catalogue (No. 2, 1901), in which they show their continuous current dynamos and motors. Their standard four-pole and two-pole semi-enclosed motors are beautifully illustrated, and some of the pictures show their application to the driving of pumping and drilling machines and boosters. Multipolar generators and motors of the open type, and large multipolar generators for direct coupling, are also detailed in specification form with accompanying diagrams.

Electric Heater.—The adjoining illustration shows a neat little device for boiling water, &c., which is being introduced by the Crown Electrical Heating Syndicate, Limited. The apparatus consists of porcelain frames, on which are wound resistance

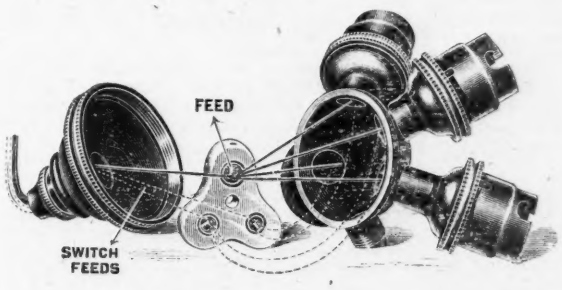


wires of a special alloy, connected by a flexible cord with a plug which can be inserted in an ordinary lampholder. With this a pint of water can be boiled in three minutes, and it is made of non-corrosive materials, so that it can be immersed in any fluid which it is desired to heat, in a tumbler, teapot, &c., with perfect cleanliness.

Glasgow Exhibition.—We have received from Messrs. W. & A. K. Johnston, Limited, what appears to us to be the best and most handy map of Glasgow and of the Exhibition that we have yet seen. On the back of the map is a quantity of useful information, and special prominence is given to the various means of getting about the city. We recommend it to those who purpose visiting the Exhibition.

Institution of Junior Engineers.—The Summer Meeting, to Plymouth and Devonport, opens on August 12th, and continues to 17th inst. There are to be visits paid to H.M. Dockyard, Devonport; H.M.S. *Cambridge* (gunnery ship) and H.M.S. *Defiance* (torpedo school ship); Keyham Dockyard Extension works; Keyham Steam Yard and Royal Naval Engineering College; Royal William victualling yard; Saltash tubular bridge; and other works and places of engineering interest in the neighbourhood. The Summer Dinner of the Institution takes place at the Hotel Continental, Plymouth, on Friday, August 16th.

New Joint Box.—We illustrate below a novel joint box which has been designed and patented by Mr. R. B. Leach, of Messrs. R. B. Leach & Co., electrical engineers, of Manchester. Its object is to entirely eliminate all soldering, rubbering and taping at present employed in the inside jointing-up of electroliers, the advantage of which is obvious. The porcelain base has three terminals fixed, well recessed fully ⅛-in. below the surface of the china,



provided with side pinch screws leading into same, these also being entirely encased in the porcelain, practically making a short circuit an impossibility. To joint up, the respective feed and switch wires are simply bared in exactly the same way as in the case of connecting up ceiling roses, lamp-holders, fuseboards, &c., and the terminals are connected up, pinching the wires tight by means of the side screws, the whole operation only taking a few minutes. The joint box has been approved by municipal Corporations, and is now being extensively used.

New Works.—According to our New York namesake, the Bullock Electric Manufacturing Company, Cincinnati, Ohio, intend to erect a plant in England for the manufacture of specialities for the British market. Mr. George Bullock, president of the company, while here will select a location for the new plant. It is said that he will interest some English capital in the new concern. This is the fourth large electrical plant to be constructed in England to which American capitalists have largely subscribed.

ELECTRIC LIGHT AND POWER NOTES.

Alloa.—The large electrical works now being erected on the north bank of the River Forth by the British Electric Plant Company, Limited, are well advanced towards completion. They are of very considerable extent, and present an imposing appearance. When in going order, the works are expected to employ 1,000 men, and will be stocked with plant to the value of £60,000. One of the principal objects of the company will be to light the town of Alloa, under contract with the T.C., which has been very active in encouraging the enterprise.

Birmingham.—The City Council has passed the recommendations of the Electric Supply Committee, given in our last issue, and has instructed the Finance Committee to borrow the sum of £128,890 for the erection of a generating station, and £75,000 for new mains and sub-stations, as well as the sum of £65,084, spent in excess of the authorised outlay.

Brighton.—Negotiations have been opened by the Clayton P.C. with the Brighton Corporation for the supply of electricity in bulk to the Council's district.

Canal Haulage.—Experiments are to be made on the River Lea with a view to the adoption of a system of electric haulage similar to that used by M. Léon Gérard on the Charleroi Canal. Mr. Chas. Tween, engineer to the Lea Conservancy Board, has taken special interest in the scheme, which is to be carried out by the Electrical Power Distribution Company, Limited. A power station has been erected near Hertford, and the lines will be commenced at that point, and will eventually be carried along the towpath to Walthamstow, a distance of about 18 miles. The lines are similar to those used by tramcars, though with a narrower gauge, and poles are erected at intervals to carry the trolley wires, whence the tractors are supplied. The company have no doubt as to the success

and out-of-sight methods.

The placing of high pressure cables in the ground, except

line pressure of 25,000 volts. The history of this interesting application will be of great value.

of the system, which they are assured will be very much cheaper than horse-power, as one tractor will be able to draw several barges. The increasing number of manufactories in course of establishment along the banks of the Lea renders the barge traffic of that river particularly important, and the new system, if successful, will be of the greatest value. The Electrical Power Distribution Company believe that their tractors will reach a speed of from three to four miles an hour. It is hoped the new system will be in working order by September.

Croydon.—The report of Mr. T. H. Minshall, borough electrical engineer, on the past year's working of the electricity department, states that during the year the capacity of the station had been increased to 4,320 H.P., and the number of lamps connected to 59,241 8-C.P., an addition of 14,119 lamps. The average price obtained is 4·24d. per unit, and there are 904 consumers.

At a meeting of the County Council last week the question of allowance for depreciation, raised by the auditor, was under discussion, but no action was taken.

Halifax.—It has been decided to construct a cooling pond at the electricity works. The quarterly contracts for the supply of coal required at the electricity works have been let as follows:—Dobb Bros., Halifax, "Wharncliffe Woodmoor," 8s. per ton; "Mauver's Main, engine nuts," 10s. 8d. per ton; Joseph Carnelly, Halifax, "Bean's double-screened Ryhill Colliery," 10s. 6d. per ton.

Italy.—The establishment of a central electric lighting station in the town of Vercelli has just been decided upon by the municipal authorities. Water power is to be utilised, but a steam boiler and engine will be installed as a reserve.

Lancaster.—At the meeting of the T.C. on July 31st the proposal of the Electricity Committee to spend £22,232 upon the extension of their generating station and plant, as recommended by Mr. W. A. Tester, the electrical engineer, was adopted. Mr. Tester recommends the erection of a new boiler and engine house with a suite of offices near the present generating station, and the installation of dynamos and engines of 1,000 KW. capacity, with the necessary accessories. About £10,170 will be required for traction purposes when the new tramways come into operation, and it is proposed to introduce machinery which can be used for both lighting and traction purposes. The pressure is to be increased from 100 volts to 200 volts.

Lewes.—On Thursday last week the County of Sussex Electrical Power Distribution Company, Limited, gave a dinner at the White Hart Hotel to celebrate the inauguration of the electricity supply system. The function was presided over by Mr. George Offor, and he was supported by the Mayor and many members of the Lewes and Chichester local authorities. There was subsequently a demonstration at the works of the specimen lamps for street lighting.

Liverpool.—The Electric Power and Lighting Committee of the Corporation has received the sanction of the L.G.B. to the borrowing by the Council of the sum of £300,000 for purposes connected with the supply of electrical energy.

London.—CLAPHAM.—Mr. Isaacson, electrical engineer at the Grand Theatre of Varieties, Clapham Junction, met with a terrible accident last week. He was leaving the engine room, which adjoins the music hall, when he failed to notice that the trap door over a tank, containing boiling water, was open, and fell in. Assistance was at once rendered him, and he was conveyed in a cab to the Bolingbroke Hospital, where it was found that he was terribly scalded all over the body. He died 48 hours later. An inquest was held on 6th inst., and the jury added to their verdict a remark about the company's negligence in not having better protection.

The County Council has agreed to lend the Woolwich Borough Council £20,000 for the electric light installation, and £27,205 for street lighting, the purchase of meters, &c.

STOKE NEWINGTON.—The Electric Committee has recommended the Stoke Newington Council to adopt a proposal empowering it to take electricity in bulk from Hackney and erect 18 lamps in High Street, between Castle Street and Manor Road. The cost of laying mains, &c., is £4,100. It has been decided to give the Committee power to enter into an agreement with Hackney to supply in bulk, if the tradesmen *en route* give a guarantee to consume a sufficient amount of power to warrant such an outlay.

CITY.—A fire occurred on 4th inst. in a joint box of the City Company in St. Swithin's Lane.

Manchester.—The Electricity Committee has recommended the City Council to raise the price of electricity ½d. per unit all round to the customers of the department from September 29th. The applications now on the books of the Corporation for the supply of electricity and awaiting connection are equivalent to over 50,000 8-C.P. lamps.

Natal.—Our Natal contemporaries publish the prospectus of the Dundee Electric Lighting and Power Company, Limited, which has been formed (with a capital of £10,000) for the purpose of erecting an electric lighting and power plant in the township of Dundee for the generating and sale of electrical energy for public and private lighting, &c.

North Berwick.—The T.C. has set on foot a plebiscite with regard to the introduction of electric lighting. The Council is not in a position to carry out the work, but Messrs. Crompton and Co., Limited, are prepared to do it on suitable terms.

Newhaven.—The B. of T. has refused to allow the transfer of the electric lighting order from the syndicate to the Council.

Sowerby Bridge.—The U.D.C. has applied to the Halifax Corporation for the "terms and conditions" upon which the latter would be prepared to supply electricity in bulk to the Council for lighting purposes. A reply has been received offering a supply at the following charges:—2¾d. per unit up to 15,000 units per annum; 2½d. per unit between 15,000 and 30,000 units; 2¼d. per unit over 30,000 units per annum.

Stockton.—The Cleveland and South Durham Electric Power Company have given notice to the R.D.C. that they propose applying to the B. of T. for a prov. order authorising them to supply electricity to the rural districts of Stockton. The matter has been referred to a special Committee.

Sunderland.—The committee having charge of the electric light have prepared their estimate for the coming half-year. This shows that whereas for the corresponding half-year there was a gross profit of £6,271 and a net profit of £1,533, for the coming half-year it is reckoned that there will be a gross profit of £8,724 and a net profit of £1,953, or £400 more than the corresponding half-year of 1900—1901. The Committee are making good progress with the new generating station, and it is hoped that by October it will be able to supply current for lighting purposes.

Tipton.—The Plans Committee of the U.D.C. has approved of a plan for an electric power station to be erected by the Midland Electrical Power Company, Limited.

Walthamstow.—The Electric Lighting Committee has recommended that application be made to the L.G.B. for sanction to a loan of £10,000 to meet the additional expenditure upon the electric lighting installation.

West Australia.—The foundation stone of a central electric power house was laid in Bendigo by the Mayor on June 26th. It is the practical commencement of an installation of electricity, for lighting the city and suburbs and supplying traction and other power, by the Electric Supply Company of Victoria, at an estimated cost of £120,000. The tram routes are 15 miles in length, and the promoters are sanguine of having them working by Christmas. The permanent way of the present steam trams will be utilised.

Worksop.—The completion of the work of laying cable and fixing standards for the lighting by electricity of the main streets and the building of works for the supply of electric energy was celebrated on Saturday by a dinner, given by the contractor for the supply works (Mr. W. Hall).

ELECTRIC TRACTION NOTES.

Aberdeen.—The tramway accounts for the past year show that in electric traction the Corporation spent £2,524 3s. 7d., of which the largest item was for energy, amounting to £1,997 12s. 7d. The charge for energy placed against the tramway department in Aberdeen is 2d. per unit. A recently completed extension from the centre of the city to the sea beach—a distance of about one mile—is now awaiting official sanction from the Board of Trade, while electric traction is being substituted for horse traction on what is known as the Maundfield section of the system. On this section, as on the recently completed extension, the overhead trolley system is being utilised. An interesting experiment in electric traction is being attempted on a section of about three-quarters of a mile on the Town's Links, where Messrs. McElroy and Grunow, an American firm, expect to successfully demonstrate the utility of their third-rail surface-contact system. The company are laying down the tramway at their own expense, and in the event of it being proved successful and considered satisfactory by the Corporation, Messrs. McElroy & Grunow will hand it over to the city for a sum of £600.

Batley.—The B. of T. has acceded to the application of the Corporation for an extension of time (six months) in which to commence the work of constructing the proposed electric tramways within the borough. The work will now have to be commenced by February, 1902. It is stated that the committee having charge of the work intend to proceed with the laying of the lines with as little delay as possible.

Brighton.—The Tramways Committee has recently been engaged upon plans for the organisation of staff for the new electric car service.

Dewsbury.—The Corporation has decided to give notice, under the Tramways Act, 1870, to the Dewsbury, Batley and Birstall Tramways Company, Limited, requiring them to sell to the Corporation such portion of their undertaking as is within the borough. It is the intention of the Corporation to lease the section to the British Electric Traction Company, who are about to construct electric tramways in the district.

Dublin.—The second half of the Hill of Howth electric tramway was opened for traffic on August 1st.

France.—Between Fayet and Chamonix a narrow gauge electric railway has just been completed and opened for traffic,

There are two power stations to supply the necessary electric energy, one at Pont Pelissier and one at Serviz, both being operated by water power.

Halifax.—The Tramways Committee have decided to equip 12 new cars with Tidswell's patent automatic tramcar guards.

Leicester.—After an exhaustive discussion the Council has unanimously adopted the recommendation that a separate central power station should be provided for the electric traction scheme. The report and scheme which Mr. E. G. Mawbey, the borough engineer, prepared for the Tramways Sub-Committee has been approved by the unanimous vote of the Council without any modification whatever, the consulting electrical engineer, Mr. E. Manville, having twice confirmed the scheme in its entirety. Strong opposition was brought against the proposed central power station. Mr. Mawbey is now preparing the necessary plans and estimates to be deposited in Parliament this year; the Lero site was selected.

London United Tramways.—At Brentford last week Alfred Rutter, greengrocer, of High Street, Brentford, was summoned for leaving his cart longer than necessary for loading or unloading. The police proved seeing it there for 40 minutes. Defendant: It's all the electric trams, sir. I have to move my cart six times in 10 minutes sometimes to let the trams go by. Mr. M. Sharpe: Why should you? You have as much right to carry on your business as they have to carry on theirs. Defendant: If I didn't move the cart it would block the cars. Mr. Sharpe: Why not block the whole system? You tradesmen ought to combine and fight the case out in a Law Court. Put a cart on the rails and let it stay there till all the cars are stopped, and then let both sides instruct counsel and have the matter fought out. You have as much right to the road as they.

It may be explained that through almost the whole length of Brentford the near rail of the tramlines is less than 2 ft. from the kerb, so that barrows, carts, &c., cannot stand in the gutter if the cars are to pass by.

Mitcham.—The County Council has approved of the light railway scheme promoted by the local authorities, subject to the Council's right to purchase the undertaking.

Newcastle.—The Tramways Committee has resolved to recommend to the City Council the acceptance of the tender of Mr. Bremner, Edinburgh, for the laying of the rails between the borough boundary and the Gosforth terminus. The tender is for £5,800.

Nottingham.—During the first week of the running of the new electric tramcars on the second completed section (Bulwell to the Great Market Place) of the Nottingham Corporation tramways, the number of passengers carried exceeded a quarter of a million. The line is four and a half miles in length, and links the densely-populated western suburbs with the centre of the city. The third section (the route to the railway stations) is now ready for use, and the Trent Bridge section is well advanced. Three sections have yet to be completed before the entire scheme will have been carried out. The Sherwood line has been utilised a good deal this summer for conveying school children's parties to Sherwood, special cars being run for this purpose.

Skene and Echt.—A special sub-committee of the Aberdeen District Committee of the Aberdeen County Council has considered an additional report by Messrs. Walker & Duncan, civil engineers, Aberdeen, showing the comparative cost of an electric and steam traction light railway from Aberdeen to Skene and Echt. They report that they have now made up a probable estimate showing the comparative cost of an electric and steam traction light railway to Skene and Echt. They had a meeting with the burgh surveyor with reference to the question of running powers over the Aberdeen tramways system, but the cost of electric traction being, in their opinion, prohibitive, they did not consider it necessary, at this stage, to proceed further with the negotiations. To enable them to arrive at the cost of an electrically-equipped light railway, they communicated with the British Thomson-Houston Company, Limited, London, and obtained from them a detailed approximate cost of electric equipment, including cables, rolling stock, &c, to which had been added the probable cost of permanent way, buildings, &c. The estimated cost for a standard gauge (4 ft. 8½ in.) light railway, with electric equipment, and rolling stock complete as above detailed, is £120,000.

South Shields.—Last Thursday week the Tramways Committee held a meeting to consider the replies received from some 75 different towns as to the electrical systems there in vogue, and after some deliberation it was almost unanimously decided to advise the Council to seek to obtain from Parliament during its next session powers to municipalise and work the tramways. Feeling in the town is very much divided as to the system to be employed, a strong section being in favour of the conduit system.

Southport.—The new electric tramways system of the Southport Tramways Company was formally opened on Thursday last week with a public function. The guests dined at the Prince of Wales Hotel, Mr. John S. Raworth presiding over a large assemblage. After dinner the chairman proposed the toast of "The Corporation of Southport." Speaking to the toast, he reviewed the progress of the tramways in Southport and the negotiations which had taken place between the Southport Tramways Company and the Town Council, which finally led to the leasing of the tramways and the introduction of electrical traction by the company.

The Mayor (Dr. Isherwood) responded.

Councillor Travis, who also responded, spoke of the tramways system and the arrangement between the Corporation and the company. On February 28th of this year the lease, he said, was signed and approved of by the Board of Trade. Work was finished on March 18th, and the lines were finished in time for the Board of Trade inspection on July 1st. The line they had passed over that day was 3 miles long, and was a double line for nearly the whole of its length. The old line comprised 6½ miles of single track. The new lines would cover the same route, but would comprise 8 miles of single track. The company had had a lease with 17 years to run, but the Corporation had granted a new lease with arrangements for running powers which should be fairly liberal on either side. They had, therefore, provided that 4½d. per car per mile should be paid by owners of cars running over lines other than their own. The intention was that the charge should be high enough to prevent one body running over the other's lines without sufficient cause and yet low enough to make it profitable.

Councillor C. E. Austin proposed the toast of "The Constructors," associating with the toast the names of Mr. R. P. Hirst (borough surveyor), Mr. R. Percy Sellon (representative of the Brush Electrical Engineering Company), and Mr. R. S. Downe (borough electrical engineer).

Mr. R. Percy Sellon responded on behalf of the Brush Company.

Mr. Hirst (borough surveyor), in responding, remarked that if the Southport Tramways Company could wear out the road in the next 21 years they were welcome to do it, for if they did Southport would be very prosperous in the meantime. Messrs. Dick, Kerr and Co. had supplied the rails and laid them down, and the work had been well done, and done up to time.

Mr. Downe and Mr. R. J. Wilton (manager of the Corporation tramways) also spoke of the way in which the work of construction had been carried out.

The lines are in two sections, laid in Roe Lane and Cambridge Road. In the last-named road most of the track is double, the length equalling six miles of single track. In Roe Lane the track is nearly all single, the total length of single track being eight miles. The rails have been supplied and laid by Messrs. Dick, Kerr & Co., the road work being done by the Corporation. The track is of standard gauge (4 ft. 8½ in.), the rails being 87-lb. girder pattern, in 40-ft. lengths. The Dicker joint has been used, and fishplates 2 ft. long, with six bolts. Tie bars, 2 ft. long by ⅜ in., occur at intervals of 10 ft. In the overhead work, the single bracket system has been adopted, the poles and brackets being supplied by Messrs. R. W. Blackwell & Co. The brackets are generally 16 ft. long, the trolley wire being carried 20 ft. 6 in. from the roadway. The cars, which have been supplied by the Brush Company, will seat 22 passengers inside and 34 outside. Twenty cars were ordered, and of these ten have been received. Current for working the new system will be obtained from the power station of the Southport Corporation at a charge of 2d. per unit up to the first 100,000 units, 1¾d. per unit for the second and third hundred thousand units, 1½d. per unit for the fourth and fifth hundred thousand, and 1¼d. for all over half a million units per annum.

Sunderland.—The line of tramway reaching from Sunderland to Grangetown, a distance of about 1½ miles, which formed the latest extension of the municipal tramway system, has just been completed, and is waiting for an official inspection prior to opening. When this line is open passengers will be able to go above 4 miles without a change of car from the extreme south of Sunderland to its extreme northern boundary.

Surrey.—At the meeting of the Surrey County Council last week it was stated that in spite of Lord Morley's decision that the County Council was not a tramway authority, nevertheless the agents of the London United Tramways, Limited, had written, "We are instructed that the County Council may rely upon our clients carrying out all their undertakings under the terms of the sealed agreement." According to these terms the County Council can purchase in 25 years, subject to the consent of the Board of Trade and the local authorities.

Swansea.—The *Times* says that on July 31st an important question came before Mr. Hopwood, Permanent Secretary of the Board of Trade, as to whether borough councils can go outside the borough boundaries with a light railway scheme without consulting the County Council through whose district it is proposed to pass. Mr. Hopwood reserved the legal point as to whether the Board of Trade could sanction a scheme not jointly promoted by the Borough and County Councils, but suggested that an arrangement should be come to between the parties as to the railway outside the borough boundary.

Tipton.—At a meeting of the U.D.C. last week the Electric Committee reported that Mr. Greatorex, of West Bromwich, had been called in as an expert in the matter of trams, and that he had advised that it would not pay Tipton to work the tramways in the parish. The Committee recommended that a Bill should be promoted in Parliament to give power to the Council to acquire the tramways and for other purposes. The Committee's report was adopted.

Underground Railways.—Sir W. H. Preece writes to the *Times* with reference to the subject of shallow tunnel lines mentioned in the report of the Joint Select Committee of the House of Lords and the House of Commons on London Underground Railways, which we published last week, as follows:—

"The London County Council at their last meeting authorised £250 to send their tramway manager and engineer to the United States to see and report upon what is being done there. If these bodies had looked through the records of the Parliamentary Session of 1889, they would have found that a Bill for a London Central

Co., Limited, are prepared to do it on suitable terms.

electric railway has just been completed and opened for traffic.

Subway Railway was submitted to a Committee of the House of Commons to construct such a line from Holborn Circus to Piccadilly. It was supported by the late Harrison Hayter, Cunningham, and John Hopkinson, and by Lord Kelvin, Col. Crompton, and myself. It was thrown out, and London was prevented from pioneering shallow tunnels through the opposition of the London County Council."

In the House of Lords on 2nd inst., on the motion of the Earl of Morley, leave was given to the promoters of the following Bills to suspend further proceedings upon them, in order to proceed with the Bills, if they thought fit, next session:—Brompton and Piccadilly Circus Railway, Central London Railway (No. 1), Charing Cross, Euston and Hampstead Railway (No. 1), Charing Cross, Euston and Hampstead Railway (No. 2), Charing Cross, Hammersmith and District Electric Railway, City and North-East Suburban Electric Railway, King's Road Railway, Islington and Euston Railway, North-East London Railway, Piccadilly and City Railway, and West and South London Junction Railway.

In the Commons on 4th inst. Sir J. Dickson-Poynder asked the President of the Board of Trade whether, in view of the recommendation mentioned above, he proposed sending an engineer from his department to examine into the subway system now in use in certain towns in the United States and on the Continent of Europe, and to report as to the advantages afforded by the system over the underground tubes now in use in London. Mr. Gerald Balfour, in reply, said that he would consider with the technical officers of the Department whether such inquiry by the Board of Trade is desirable. "It may be that even with the information they at present possess, the inspecting officers would be in a position to deal with undertakings of this description if an effort was made by promoters to embark in such enterprises in this country. I understand that the system is also about to be tried in Paris."

Under-Sheriff Burchell and a special jury has had before it for assessment a claim for damages set up by Mr. Wm. Catlin on account of damage alleged to be caused to property at Highbury Place by the construction of the tunnels of the Great Northern and City Railway. A surveyor who appeared for the plaintiff estimated the damage and depreciation at £3,976, and thought £500 should be set down for probable future damage. The jury awarded £660 damages, and judgment was entered for this amount with costs.

Bristol.—We mentioned last week that a difference had arisen between the Bristol Tramway Company and the drivers and conductors employed on the electric cars. The result has been a sharp contest between the company and the trades union movement, to which these employés allied themselves. Mr. George White, the chairman of the company, and his directors have fought their battle with characteristic energy, and the predominant feeling in Bristol is that the result must be a complete victory for the company. The occurrence of the dispute was a complete surprise to the public, who were unaware of any grievances on the part of the men. According to the men's version, some of their number desired to become trades unionists, and joined the Gas Workers and General Labourers' Union, whereupon a number of them were discharged from the service without reason being assigned. An active propaganda was carried on by the representatives of the Union, and there were more recruits to its ranks, and more dismissals. As a protest against what was termed this "high-handed action" on the part of the company, nearly 400 of the men sent in notices, to expire on the Sunday evening before Bank Holiday, when traffic on the electric cars assumes very large dimensions. The company had no difficulty in finding new employés, but very many of the new comers were inexperienced; men brought from other towns, in several cases, went back on finding a dispute in progress. In addition to this the attitude of the sympathisers of the men became so threatening that it was deemed desirable to stop the cars at dusk and to have on duty a large number of police. The company, without waiting for the expiration of the notices, paid off the men several days before their term had expired, and reduced their service to a fraction of its former proportions. In the course of the controversy the men declared that they were engaged to work 10 hours per day, but were employed for considerably more. The company's reply disputed the men's arithmetic, and pointed out that while some days exceeded the 10 hours, others were less, and the average was less than the men stated. Further, the directors were led to believe that this trades union movement among their employés was part of a settled plan of campaign instigated by outsiders, which had for its object an attempt to force the company's hand on the eve of Bank Holiday traffic, and they contended they were justified in resisting this attack to the uttermost. A number of their employés, they said, had been coerced into joining the Union, and hence it became necessary to take prompt action. By Saturday night the full number of drivers and conductors had been made up by the employment of new men and the reinstatement of former employés who threw up the Union. To free these from outside influence, a huge camp was formed at the Brislington depôt, where the company have an enclosure occupying several acres; tents were there erected, hundreds of bedsteads and spring mattresses purchased, a commissariat department organised, and nightly amusements arranged. Bank Holiday was expected to prove the crux of the struggle. To guard against possible violence, large bodies of police from various parts of the country were brought quietly to Bristol, and every member of the Bristol force was on duty. The day passed, however, without any serious disturbance. There were isolated cases which led to arrests, and day after day defendants have been dealt with by the Bristol magistrates for assaults and interference with the men on the cars. On the whole, however, the cases have not been serious, and the union speakers have strongly discouraged violence. The stoppage of cars at nightfall has been a source of great inconvenience, especially to suburban residents, who had come to rely on the fine service of the company. Meanwhile the training of drivers and conductors has been daily proceeding, and the number of cars has been increased. The union men are thus left out in the cold, and the conviction has been produced that they must have the worst of this sharp tussle with the Bristol Tramway Company.

London.—At the half-yearly meeting of the North Metropolitan Tramways Company on Tuesday Mr. George Richardson said that as to the adoption by this company of electricity, they had an arrangement with the London County Council. When the Council called upon the company to "electrify" the line, they would have to find the money and the company would have to pay the interest on it. As soon as the Council were ready to have the line "electrified," the directors would be prepared to do it, but until the Council took the initiative the company could do nothing. Two experts had been sent out by the Council to America to see the best installation that could be made, and the best way of putting it down, but until those gentlemen returned the County Council would not move in the matter.

West Bromwich.—The negotiations between the Corporation and the South Staffordshire and Birmingham and Midland Tramways Companies for the purchase by the Corporation of the tramways within the borough, have now been brought to a conclusion, and terms have been agreed upon. The Council are to be recommended to make application to the Board of Trade for sanction to borrow the sums of £5,500 and £32,000, with any further capital necessary, repayable by instalments within 30 years. It has also been decided that Mr. R. C. Quin be appointed to design and supervise the construction of the overhead electrical equipment, to lay the cables, to see to the bonding of the rails, and to be responsible for the reconstruction of the same, and to act as consulting engineer for the whole scheme, for an inclusive fee of £2,000.

Wolverhampton.—The T.C., at their meeting last week, decided that the tramway be extended on the Waterloo Road, from its junction with Newhampton Road to the entrance to Molineux Grounds, at the scheduled rates specified in the existing contracts with Mr. Herbert Holloway and the Callender Cable and Construction Company, Limited.

TELEGRAPH AND TELEPHONE NOTES.

Eastbourne Telephones.—It is stated that the National Telephone Company have agreed to sell their Eastbourne undertaking to the Town Council for 21 years' purchase on the last year's profit.

Glasgow Telephones.—From a discussion at the last meeting of the Corporation, it seems that so far 1,050 connections to the municipal exchange have been made out of 5,256 applications.

Huddersfield Telephones.—A meeting of representatives of the rural authorities within the proposed Huddersfield municipal telephone area was held at Huddersfield last week, and after the terms and conditions of the scheme had been discussed, a committee was appointed to wait upon the Electricity Committee of the Corporation, with the object of securing better advantages financially for subscribers to the system.

Liverpool Telephones.—The Corporation were on Wednesday to discuss the advisability of establishing a municipal system of public telephonic communication.

Oldham Telephones.—The Finance Committee of the Corporation is making inquiries *re* municipal telephony. The Corporation now pays the National Company £500 per annum.

The Pacific Cable.—The Pacific Cable Bill is backed by Mr. Chamberlain, Mr. Austen Chamberlain, and the Chancellor of the Exchequer, and its full title is "A Bill to provide for the construction and working of a submarine cable from the island of Vancouver to New Zealand and to Queensland." According to a financial paper, the preamble states that it has been arranged that the amount required for the construction and working of the cable (including interest at the rate of 3 per cent. on borrowed money) shall (so far as not covered by receipts) be ultimately provided as to $\frac{5}{16}$ths by His Majesty's Government, and as to $\frac{11}{16}$ths by the Governments of Canada, of the States of New South Wales, Queensland, and Victoria, and of New Zealand, and that any profits arising from the cable shall be divided in the same proportion. The Treasury is authorised to provide the necessary sums out of the consolidated fund to an amount not exceeding £2,000,000, and powers are taken to borrow money during construction at the rate of 3 per cent. by means of terminable annuities. The construction and working of the cable will be placed under the control and management of a board, the constitution of which is detailed in a schedule attached to the Bill. The representatives of the Home Government are Sir Spencer Walpole, K.C.B. (chairman), Mr. G. E. Y. Gleadowe, C.M.G., and Mr. W. H. Mercer. Lord Strathcona and Mount Royal and Mr. Alexander Lang represent the Government of Canada. The Hon. Henry Copeland and the Hon. Sir Andrew Clarke, G.C.M.G., represent the Governments of New South Wales, Victoria and Queensland, and the Hon. W. P. Reeves represents New Zealand.

The *Times* correspondent at Ottawa says that a proclamation has

been issued giving effect to the Pacific Cable Act of last Session. While still contending that the privileges granted by New South Wales to the Eastern Extension Company are inimical to the future prospects of the Pacific Cable scheme, yet Canada, anxious for the consummation of this great Imperial project, waives her objections, and is now prepared to pay five-eighteenths of the total cost.

In the House of Commons on 2nd inst., says the *Times* Parliamentary report, Captain Norton asked the Secretary to the Treasury whether his attention had been called to a speech of the Right Hon. Sir R. G. W. Herbert, G.C.B., at the half-yearly general meeting of the Telegraph Construction and Maintenance Company, held on July 16th, in which he stated that the company in question would produce the Pacific cable towards the end of next year without interfering with their other work which was more pressing; whether his Majesty's Government had agreed to the proposed postponement of construction; whether Sir R. G. W. Herbert was at that time acting as an official of the Colonial Office; and, if so, whether it was in accordance with the rules of the service that he should make such a statement. Mr. Austen Chamberlain in reply said that he had seen no report of the speech referred to. "Sir R. Herbert was not at the date mentioned a member of the Civil Service. The contract for the Pacific cable requires that it should be completed and laid by December 31st, 1902. The Government has no reason to believe that there will be any postponement of the construction, and, as already stated in reply to a question in this House, I am informed that the engineers of the Pacific Cable Board are satisfied of the ability of the contractors to complete the work by the contract date."

Telegraph Poles in the Philippines.—Our New York exchange says that it has been found that the life of a telegraph pole in the Philippines is little more than one year. The white ants which proved so destructive to the poles on the line of the Cairo-Cape system in Africa are also found in the Philippines, and aid the climate in the work of destruction.

The Telephone Service.—Mr. Austen Chamberlain said in the House of Commons on 4th inst. that the establishment of the Post Office telephone system in London will not affect the provision of private wires of moderate length by the Postmaster-General. "They will continue for the present to be provided at the same rates and under the same conditions as now. It is, however, hoped that in many cases the exchange service will serve the same purposes as more costly private wire systems."

CONTRACTS OPEN AND CLOSED.

OPEN.

Amsterdam.—September 2nd. H.M. Consul at Amsterdam states that tenders are invited by the Municipality of Amsterdam for the supply of "electrical tram-carriages arranged for above-ground supply of electricity, and for about 5,000 tons of grooved rails for tramways, with necessary appurtenances." Particulars may be obtained from the Director of the Municipal Tramways, Nieuwe Achtergracht, No. 164, Amsterdam.

Aston Manor.—September 4th. Water-tube boilers, 200-KW. and 500-KW. steam dynamos, balancer, switchboard, crane, and arc lamps for the D.C. electricity works. See "Official Notices" to-day.

Birkenhead.—August 23rd. The Corporation wants tenders for steam engine and dynamo for traction. See "Official Notices" to-day.

Bournemouth.—August 29th. Boilers, superheaters, economiser, feed pumps, pipework, &c., for the T.C's tramways power station. See "Official Notices" to-day.

Christiania.—August 12th. Tenders are invited by the Norwegian Government for battery zinc, conducting wires, soldering tin, sal-ammoniac, and signboard shields for the Telegraphs Administration. Specifications, &c., may be inspected daily at the office of the Controller of Material, Kongens Gade 21, Christiania.

Croydon.—August 26th. The electric wiring and fitting of the Lunatic Asylum, Warlingham, Surrey. See "Official Notices" August 2nd.

Darlington.—August 22nd. Lancashire boiler, 350 H.P. engine and C.C. dynamo, and steam, &c., piping, for electricity works extensions. See "Official Notices" August 2nd.

Doncaster.—August 17th. The Corporation wants tenders for cables and wires for tramway feeders, also feeder and section pillars. See "Official Notices" August 2nd.

Edinburgh.—September 9th. For the electric lighting installation for the second portion of the Colinton Mains Fever Hospital (800 points), for the Corporation. See "Official Notices" to-day.

Farnworth.—August 12th. The U.D.C. wants tenders for a car shed traverser. See "Official Notices" July 26th.

France.—August 12th. Tenders are being invited until August 12th, by the French Ministry of Post and Telegraphs in Paris, for the supply of a large quantity of lead-covered telephone cable with 21 conductors. Tenders to be sent to Le Serio-Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris, whence particulars may be obtained.

Glamorgan.—August 24th. For the lighting by electricity of Parc Gwyllt Asylum, near Bridgend. See "Official Notices" August 2nd.

Leigh.—August 24th. A steam dynamo for the electricity works. See "Official Notices" to-day.

Manchester.—August 14th. The Electricity Committee wants tenders for H.T. switchboards, exciter and auxiliary switchboards for the Stuart Street generating station, also high and low tension boards for sub-stations. See our "Official Notices" July 12th.

Manchester.—August 17th. The Tramways Committee wants tenders for the following, viz., electrical accessories, machine tools, &c, car cleaning materials, veterinary services. Mr. J. M. M'Elroy, general manager, Tramway Department, 55, Piccadilly, Manchester. See "Official Notices" to-day.

Mansfield.—September 5th. Refuse destructors for the E.L. Committee. See "Official Notices" August 2nd.

Middlesbrough.—September 3rd. Mechanical coal-handling plant for the electricity works. See "Official Notices" August 2nd.

St. Annes.—August 23rd. A 180-KW. c.c. direct coupled steam dynamo for the Council. See "Official Notices" to-day.

Walthamstow.—August 30th. Tenders for house wiring for the U.D.C. See "Official Notices" to-day.

Watford.—August 21st. Wiring the public library nd technical school for the U.C. See "Official Notices" to-day.

Wigan.—August 10th. The Corporation wants tenders for enclosed motors and starters, 12 months' supply, 1 to 50-H.P. See "Official Notices" July 26th.

Willesden.—The D.C. wants tenders from companies willing to contract for the equipment of their proposed electricity works. See "Official Notices" August 2nd.

Worcester.—August 23rd. The Corporation wants tenders for water-tube boilers, economiser, pipes and pumps, steam dynamos, motor alternator and booster, Korting condensers, electric pumps, switchboard, crane, and battery for the new electricity works. See "Official Notices" July 26th.

CLOSED.

Kingston.—The seventh annual report of the Borough Electrical Engineer (Mr. J. E. Edgcome) shows that large extensions of the plant and mains have been made. The number of consumers has increased from 311 to 376, and the 8-C.P. lamps connected from 16,130 to 18,899. The gross receipts during the 12 months from the sale of current were £6,562 11s. 4d., as compared with £7,511 18s. 9d. for the 15 months preceding. The expenditure during the year was £9,283 13s., as compared £7,559 17s. 8d. for the previous 15 months, so that the total deficit last year was £2,721 1s. 8d. The cost of coal alone went up from £2,407 14s. 1d. in the previous 15 months to £4,236 6s. 8d. last year, and there was a considerable increase also in management expenses and in interest and repayment of loans. The result of the year's working shows that the revenue derived was equal to 5·09d. per unit sold, while the cost was 7·197d. The total number of units supplied was 308,860.

Peterborough.—The Corporation have placed the contract for 200-H.P. lighting and tramway set with Willans engine and spare armature with Messrs. Bruce Peebles & Co.

Wolverhampton.—The T.C. last week authorised the Tramways Committee to accept a tender for supplying, laying, and erecting complete the necessary feeders, conduits and feeder switch pillars for the electrical equipment of the route of tramway running between Darlington Street, at its junction with Waterloo Road South and Tettenhall Road, and its junction with Newhampton Road West, not exceeding in amount the scheduled rates included in the tender of the Callender Cable and Construction Company, Limited, for the execution of similar work on the Newhampton Road, &c.

NOTES.

Water-tube Boilers.—The *Westminster Gazette* says that the Admiralty have ordered his Majesty's new sloop, *Espiegle*, to carry out special experimental water-consumption trials with Babcock & Wilcox water-tube boilers, for the information of the Boiler Committee.

been serious, and the union speakers have strongly discouraged violence. The stoppage of cars at nightfall has been a source of

Reeves represents New Zealand.

The *Times* correspondent at Ottawa says that a proclamation has

The International Engineering Congress.—We are able to give the following details regarding this approaching congress, obtained from the official programme issued by Mr. J. D. Cormack, the general secretary. We may first refer to the Electrical Section (No. IX) :—

Office Bearers.

Chairman: W. E. Langdon.
Vice-Chairmen: R. K. Gray and Prof. Magnus Maclean, D.Sc.
Honorary Secretary: W. G. Macmillan, 28, Victoria Street, Westminster, London, S.W.
Meetings:—Natural Philosophy Lecture Theatre. — Tuesday, September 3rd, 11 a.m., and then visit to Exhibition; Wednesday, September 4th, 10—1; Thursday, September 5th, 10—1.
Papers:—Chairman, Short Introductory Address. "Notes on the Electrical Exhibits in the Exhibition."
"Electricity Supply Meters of the Electrolytic Type," by J. R. Dick.
"The Relative Advantages of the Three, Two and Single-Phase Systems for Feeding Low-tension Networks," by M. B. Field.
"Modern Commutating Dynamo Machinery, with Special Reference to the Commutating Limits," by H. M. Hobart.
"The Protection of Trolley Wires," by Prof. A. Jamieson.
"Kelvin's Electric Measuring Instruments," by Prof. M. Maclean.
"Continuous Current Dynamo Design," by H. A. Mavor.
"The Use of Electricity in the Propulsion of Road Vehicles," by A. R. Sennett.
"High Speed Railways," by Herr Lasche, of Berlin.

In the other Sections the following are among a host of papers down for reading :—

"Electrolysis of Gas Pipes," by Dr. Leybold, of Hamburg.
"Recent Tramway Practice," by James More.
"Alternating Currents and their Possible Application to Mining, Part II.," by Sydney F. Walker.
"Elmore Ore-Concentration Process," by A. Stanley Elmore.
"On the Profitable Utilisation of Power from Blast Furnace Gases," by B. H. Thwaite.
"On a Mechanical Gas Producer," by Benjamin Talbot.
"Notes for Discussion on Shipyard Equipment," by Prof. J. H. Biles.
"Works of the Dortmund and Ems Canal," by H. Hermann, Germany.
"Modern Practice in Railway Signalling," by I. A. Timmis.
"The Economy of Electricity as a Motive Power on Railways at Present Driven by Steam," by Prof. C. A. Carus-Wilson.
"Trials of Steam Turbines for Driving Dynamos," by Hon. C. A. Parsons and G. Gerald Stoney.
"The Cassel Self-Regulating Water Wheel," by E. C. de Segundo.
"A Premium System of Remunerating Labour," by Jas. Rowan.
"Application of Metric System to Workshops," by Arthur Greenwood.
"Power Required to Drive Marine Engine Works and for Electric Lighting," by James Crighton and W. G. Riddell.
"Workshop Methods," by William Weir and J. R. Richmond.
"Rating and Testing of Electrical Machinery," by Gisbert Kapp.
"Some Experiences and Results Derived by the Use of Superheated Steam in Engines," by R. Lenke.
"A Regenerative Steam Accumulator and its Application to the Utilisation of Exhaust Steam," by A. Rateau.

Improvements in Electric Furnaces.—Mr. Joseph Bastick writes to us regarding a paper on "A New Electric Furnace," which appeared in our issue of July 26th, a paper, by the way, not from the pen of Mr. A. Parker, as our correspondent assumes. The purport of Mr. Bastick's communication is to explain that nearly all the improvements in electric furnaces attributed to Mr. Parker were previously patented by himself, and he forwards us four specifications, Nos. 29,008 of 1897, 29,009 of 1897, 29,010 of 1897, and 29,011 of the same year, to prove his contentions. Mr. Bastick's furnaces have been working, we are informed, since 1898, and are patented in this country and in all the English Colonies; judging from his communication and the specifications, he makes out a good case for himself.

Electrical Display at Niagara.—Mr. Orrin E. Dunlap writes that an apparatus invented by C. E. Skinner, insulation expert of the Westinghouse Electric and Manufacturing Company, and which is being experimented with at Niagara Falls by Paul M. Lincoln, resident electrician of the Niagara Falls Power Company, "is attracting much attention from the fact that, while it furnishes the basis of a magnificent electric sign display, it also produces artificial thunder and lightning in quantities and quality that form earnest competition with the genuine article. This electric sign is a wonder. So perfect are its workings that when it is in operation one observes a change in the atmosphere similar to the effect of a thunder and lightning storm. The intermittent flashes of lightning, the detonation of the thunderclaps, are all produced with such close resemblance to nature's offering in the same line that a person is forced to wonder how it is all accomplished. Mr. Lincoln has the sign erected in the transformer station at the Falls, where there is plenty of current of high voltage to operate it, and when it is working it is the liveliest electrical feature Niagara has ever seen. When the current flows to the sign at a low potential each letter appears surrounded by a violet fringe of light, and then, as the tension is increased, wriggling, rootlike streamers of light shoot out in a manner that is weird and beautiful in the extreme. These vary in length as the voltage rises, and soon each letter is surrounded by the dazzling halation of strange light, in still stranger and more remarkable forms. So far, when the conditions described exist, the discharges are but partial, and the onlooker wonders what is going to happen when the voltage is increased. The pressure of the current is increased, and the complete discharges begin to occur. This condition is well portrayed about the word 'Niagara,' the long streamers of light representing the complete discharges. As each one of these is produced it is accompanied by a sharp report, which, with the flashes of lightning, give a true storm effect. The sign is seen at its best when the current is at about 40,000 volts, and it makes a wonderful exhibition. It is understood that the sign will be seen at the Pan-American Exposition. If so, it will be one of the most attractive and inspiring electrical features in the line of weirdness seen there. There is no end to the manner in which the invention can be utilised. The experiments conducted with the invention by Mr. Lincoln at Niagara Falls have demonstrated its great value."

Personal.—Mr. Alfred Schwartz, of the South-Western Polytechnic, Chelsea, is to be elected Professor in Physics and Electrical Engineering in the Manchester Municipal School of Technology.

We read in the *Electrical World* that Mr. H. Bevis, of the General Electric Company, Limited, is again visiting the United States. Our contemporary adds that his trips to the United States are becoming quite numerous.

The Wolverhampton Town Council last week increased the salary of the borough electrical engineer (Mr. Shawfield) from £300 to £450 a year as from April 1st last.

The Committee of Visitors of Rainhill Asylum have appointed Mr. Edward Fazackerley to the position of electrical engineer. Mr. Fazackerley has for some years past been engaged, on behalf of Messrs. Mather & Platt, Limited, in supervising the erection, testing and running of various town lighting and tramway contracts carried out by them, including the Doncaster and Great Grimsby electricity works, and the Blackpool and Fleetwood tramways.

Mr. J. W. Eastwood, chief assistant of the outdoor staff of the Bradford electricity works, was last week presented with a marble clock and pair of ornaments by his friends connected with the undertaking, on the occasion of his marriage.

The Central Station Superintendent.—Some months ago we mentioned the fact that our New York namesake was inviting American electrical engineers to submit contributions on the qualifications, &c., of the central station superintendent. Our contemporary has now awarded its prize for the most meritorious paper sent in, to Mr. J. H. Vail. The subject is one of great interest to station engineers in this country, as indicating the best points in the best of their American *confrères*, and we believe that the article, which we reprint, will be read with profit.

New Company Announcement.—In consequence of the growth of their electrical engineering business, and for convenience, Messrs. Witting Bros. have decided to make this branch of their business a separate one, and to form for its transaction a special company, with the title "Witting Bros., Electrical Engineers and Contractors, Limited." All orders and contracts placed with the firm and unexecuted on July 1st, will be transferred to the new company, who will take over all liabilities on that date. Mr. A. C. Eborall will continue to act as chief engineer to the new company.

(*Continued on page* 235.)

GLASGOW INTERNATIONAL EXHIBITION, 1901.

V.

The exhibit of Messrs. Willans & Robinson is one of the largest steam electrical plants ever shown in operation by a single firm at an exhibition, with the exception, perhaps, of the Paris Exposition of 1900, where, it may be noted, they were also largely represented, and showed a 3,000-H.P. engine coupled to a dynamo. This set, which obtained a *grand prix*, was employed in supplying light and power, and was one of the largest steam dynamos there. The exhibit at Glasgow is of the same total power as that at Paris, but is divided into two engines, each having a normal output of 1,200 H.P. and a maximum of 1,500 H.P. Both engines were running before the opening of the Exhibition.

The engines are triple-expansion, of the firm's usual vertical central-valve 3 V type, fitted with automatic expansion, and run at a speed of 230 revolutions per minute. They are supplied with steam at 180 lbs. pressure, and are intended to work with condensation, though at present they exhaust into the atmosphere.

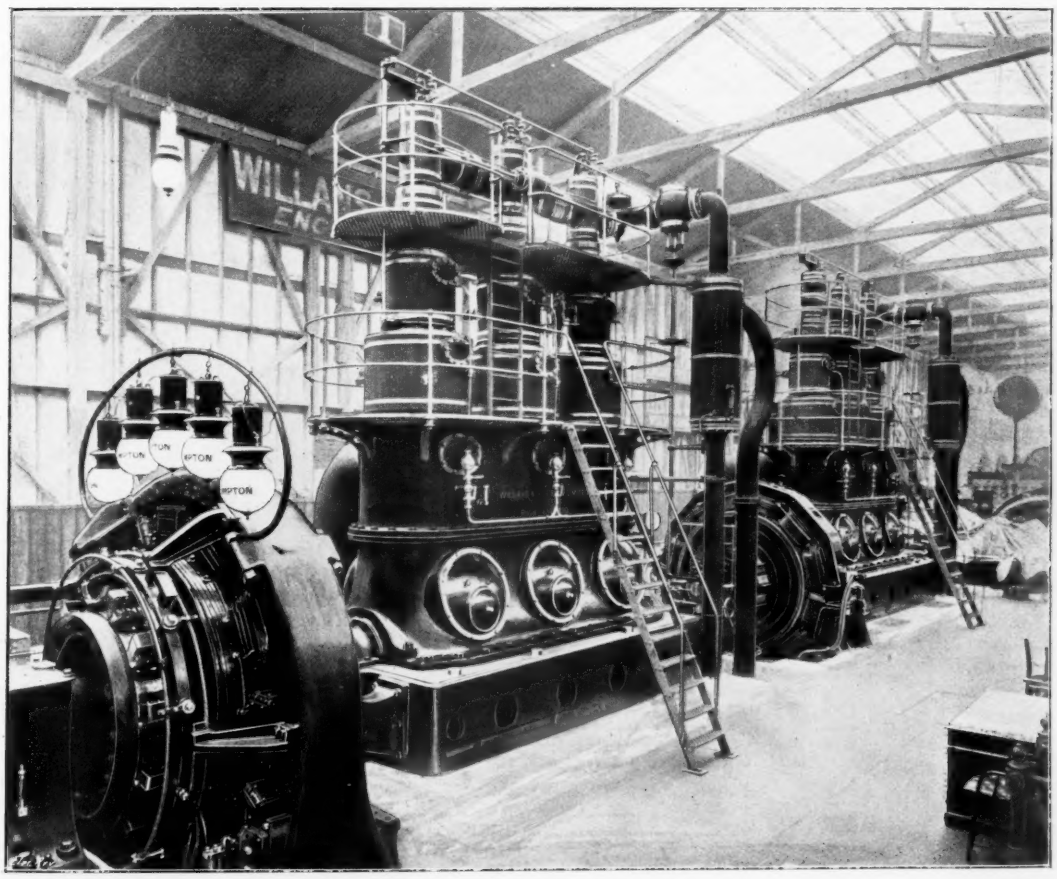
Each engine has three cranks at 120°, with a complete tandem engine placed over each, having L.P., I.P. and H.P. cylinders, 37·5 in. (950 mm.), 23·6 in. (600 mm.) and 15 in. (380 mm.) in diameter respectively, thus giving the same turning moment on each, at any load. The stroke is 17 in. (430 mm.). The weights of the three sets of moving parts are equal, a property which, for reasons now well known, ensures complete freedom from vibration.

The cranks run in an oil bath contained in the bedplate, and by their splash afford copious and automatic lubrication to the moving parts. As the engines are single acting, caps are not required upon the bearings, which are therefore continuously exposed to the lubricant. Oil cups are fitted to the buffer cocks for use when the engine is required to run slowly

The engines differ in no way from smaller sizes, except that the crank chamber is divided longitudinally to facilitate removal of the crankshaft without complete dismantling; one of our views shows the engine with one-half of the crank chamber removed. Each engine is provided with Poole's patent "Aegis" steam trap, an ingenious device specially designed to remain steam-tight under high steam pressures.

The total floor space required by each engine is 16 ft. by 8 ft. 6 in. One engine has a small fly-wheel faced to form a coupling, and the other merely a coupling disc, the necessary fly-wheel power being provided by the revolving part of the dynamo. In both cases the couplings are bolted directly to flanges upon the armature castings, not to couplings upon the shafts.

One engine is coupled to a dynamo by Messrs. Crompton and Co., having a normal output of 700 KW. at 520 volts, and a maximum for one hour of 960 KW. at 510 volts; the other drives a dynamo of the same output by the British Schuckert Electrical Company. During the Exhibition both



Willans & Robinson 1,200-I.H.P. Engines driving Crompton and Schuckert Dynamos.

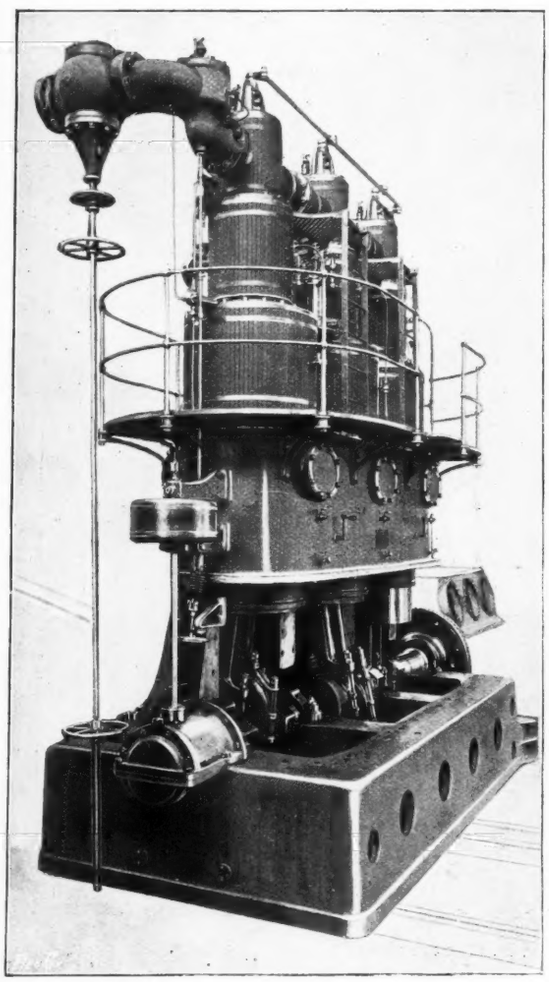
sets will be employed in supplying light and power, and at its close will become the property of the Glasgow Corporation, and will be removed to one of their electric stations, where Willans engines to the extent of some 14,000 H.P. are already installed.

The generator exhibited by Messrs. Crompton is of their latest type, suitable for either lighting or traction; the field magnet has 12 poles, and is compound wound for a rise of pressure from 500 volts at no load to 550 volts at full load, but the series coils are of course disconnected while the machine is used for lighting. The magnet frame is of cast-iron, and is divided into four parts; the poles are of wrought-iron. The armature core is of the slotted core barrel-wound type, 7 ft. 6 in. in diameter, and weighs 18 tons; it is wound with 1,500 conductors of copper strip, shaped on formers, six conductors being laid in each slot. The commutator has 750 sections, and is very massive. The most striking feature, indeed, of the whole machine is its exceptionally strong and substantial construction, which cannot but con-

duce to durability and low cost of maintenance. Owing to the great weight of the armature, a separate fly-wheel was regarded as superfluous, and has not been fitted.

The Schuckert machine is of a similar type; the field magnet frame is of cast-iron, in two parts, with 12 inwardly projecting poles. The armature is drum wound, with slotted core, the winding consisting of a layer of square bars. The commutator is much smaller in diameter than the armature, with evolute connections to the winding screwed to the commutator bars.

A great number of small carbon blocks—no less than 15 per pole — held in very light aluminium brush-holders, collect the current from the commutator; the brush gear is carried by a star wheel mounted on the end bearing, so as to give the greatest accessibility to the brushes and commutator. This is a striking feature of the machine, and gives it an air



Willans 3 V Engine, showing half the Crank Chamber Removed.

of extreme neatness, a quality which, combined with the high finish, has excited much admiration. Steps and hand-rails are provided to facilitate attention to the brushes, and the adjusting gear is fitted with a hand-wheel at each side of the bearing—a very convenient arrangement. The engine driving this set is provided with a fly-wheel coupling, as the armature is lighter than in the case of the Crompton dynamo.

The shunt coils are wound upon zinc spools, from which they are insulated by mica; the series coils are wound on alternate poles only.

The end connections are made by means of evolutes, which are entirely surrounded by air, and are thus well insulated and cooled, while permitting the free flow of air through the armature.

The exhibit of Messrs. Davey, Paxman & Co., Limited, in the engine room, should be considered in conjunction with their boiler, superheater, &c., in the boiler house. It consists of a horizontal compound engine, having two cranks at right angles, and rated at 650 B.H.P. when supplied with steam at 180 lbs. pressure, at 150 revolutions per minute. The cylinders are 15½ and 27 in. in diameter, with a stroke of 30 in. The engine is coupled to an E.C.C. traction dynamo, which is fixed between the cranks. The diameter of the shaft is 14 in. at the middle, 11 in. in the journals, which are 20 in. long. The main bearings are 8 ft. 8 in. centres.

Automatic expansion is provided by the usual Paxman gear, the cut-off being varied on both cylinders. There are two eccentrics at each end of the crankshaft, with short and long stroke respectively, which vary both the lead and the travel of the slide valves. There are two piston valves in tandem on the high pressure cylinder, and two in parallel on the low pressure. All the eccentrics are worked by light shafts co-axial with, but separated from, the main shaft, and driven by cranks from the main crank-pins; by this means the use of large eccentric sheaves and straps on the main shaft is avoided, and the main bearings are brought as close together as possible—a very important feature in the case of engines which drive dynamo armatures keyed direct on the shafts.

As the engine has to work with highly superheated steam, the steam port is at the *middle* of the high pressure piston valve, and the exhaust port at the end; thus the hot steam does not come in contact with and burn the packing of the valve rod stuffing box. No trouble is experienced with the main piston rod.

A reheater in the receiver between the cylinders is fed with superheated steam from the boiler.

Lubrication is provided for in three ways: by gravitation, by force pump, and by oil cups. Usually the oil is pumped into a cistern by a pump on the engine, whence it flows under a head of 18 ft. to all parts of the engine. All used oil is returned to a reservoir in the engine bed; a neat device on the crank for this purpose is noteworthy. Nokes's lubricator, driven by a ratchet, is fitted to each cylinder.

The governor, which is of the three-ball spring type, is driven by helical gear from the side shaft on the low pressure side. An arrangement is provided by means of which the speed can be altered while the engine is running, without varying the percentage change between light and full load—a point usually overlooked in this connection. The governor spindle runs in ball bearings, without a footstep.

A fly-wheel, weighing 9 tons and 10 ft. 6 in. in diameter, is provided.

Messrs. Davey & Paxman have experienced very hard luck in their foundations, which were put in by the Exhibition authorities, and proved to be altogether inadequate, owing to the very boggy nature of the ground; consequently, it was impossible to run their engine pending extensive excavations and additions to the concrete bed. However, during the Exhibition the company intend to carry out exhaustive tests, from coal to kilowatt-hours, with the plant which they exhibit, under the supervision of Prof. Ripper. The whole exhibit shows a high standard of excellence, and is well worthy of a careful examination; the results of the tests will, without doubt, be of great interest and value.

The dynamo, exhibited by the Electric Construction Company, Limited, is of their standard 500-KW. high-speed traction type, wound in this case for a speed of 150 revolutions per minute, and giving an output of 300 KW. at 500—550 volts.

The machine is noteworthy for the care with which details have been worked out, and for massive construction combined with high finish. The frame is circular, of high-permeability cast-iron, this material being adopted in order to obtain the utmost rigidity, together with magnetic stability. It is divided on the horizontal plane, and the lower half is provided with substantial feet, which are bolted to independent foundation plates. There are eight internally projecting laminated magnet cores, formed of high-permeability rolled-steel plates; these are cast into the ring, and are provided with removable pole faces of special shape, which form a means of magnetic adjustment, should this be necessary. The armature is mounted approximately midway upon the engine crankshaft, and is carried by a massive

cast-iron barrel, rigidly keyed to the shaft and terminating in an enlarged flange coupling, which is bolted direct to the fly-wheel and which carries practically the whole of the torsional stresses.

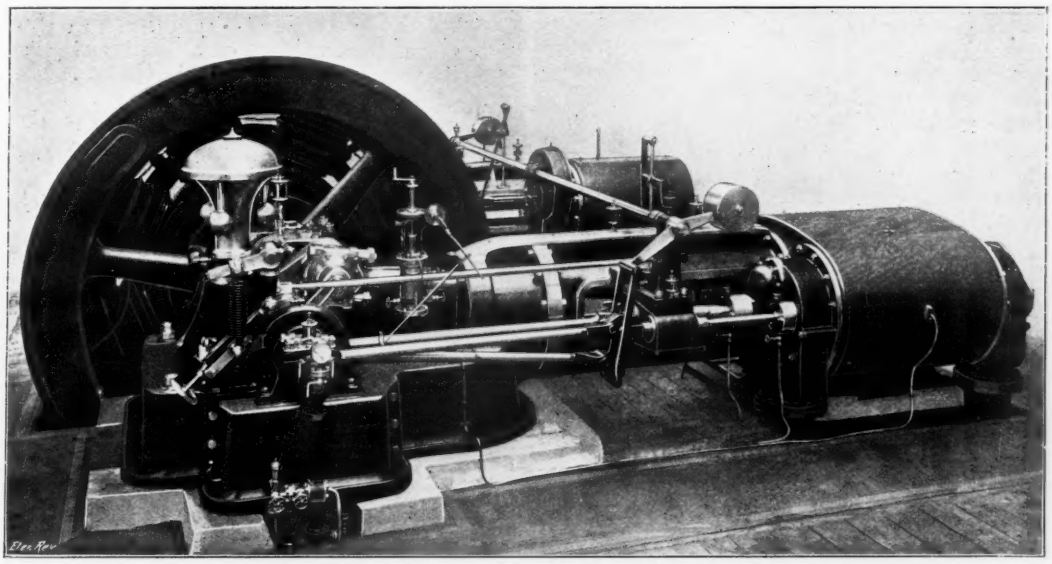
The armature core is of finely laminated charcoal iron, specially selected for low hysteresis loss, the whole being divided into narrow discs, between which air is forced for ventilating purposes. This method permits of considerable excess load being carried with comparatively small rise of temperature. The armature winding is of the usual barrel type, the conductors being machine formed, and the loops are jointless. Each loop is subjected to an independent pressure test of 3,000 volts alternating. The winding is secured by the usual hard wood wedges in the slots and by metal bands, with cotter joints for the end connections.

The magnet coils are wound with pyramidic winding, which is a feature of most of the E.C.C.'s larger machines. The series coils are of high conductivity rectangular section copper, formed into two spirals on each limb, and are removable without interference with the shunt coils. The commutator consists of 768 bars.

The brush connections are concealed from view by being placed in a cast-iron ring, which also carries the brush pillars, and which is supported by brackets attached to the yoke. The brush ring is adjustable by the usual hand-wheel arrangement in connection with a worm and rack, and rides upon friction rollers fitted in the lower guides.

The design of the machine throughout is on very liberal lines, and the electric and magnetic proportions are such, that the machine is sparkless at all loads, with the brushes in a fixed position.

The temperature rise after eight hours' run at full load

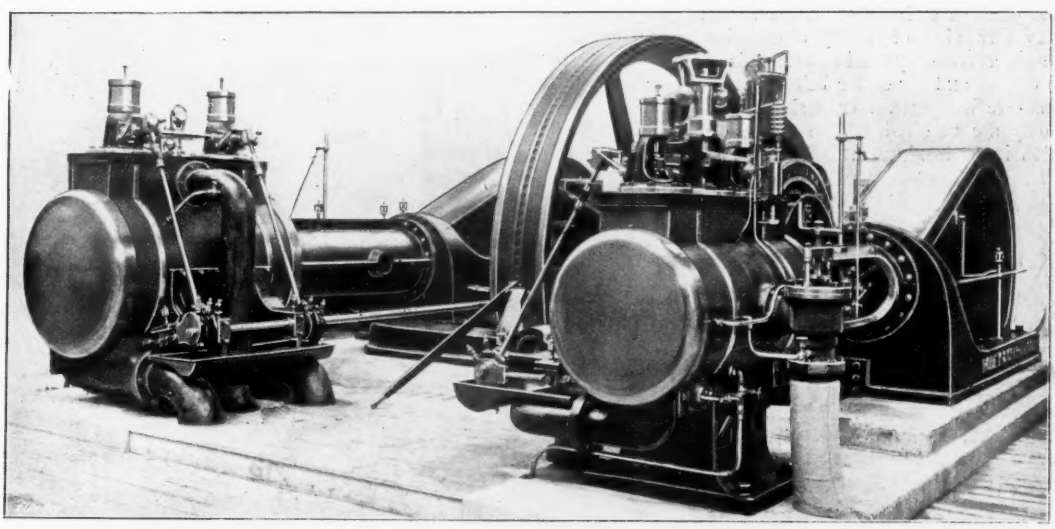


Davey-Paxman 650-b.h.p. Engine and E.C.C. Traction Dynamo.

50° F., and the electrical efficiency ranges from 96·6 per cent. at full load to 94·7 per cent. at ¼ load.

Messrs. Robey & Co., Limited, Lincoln, have a large exhibit, consisting of a low speed horizontal engine and two high speed vertical engines driving dynamos. The engines are all of high-class workmanship and beautifully finished.

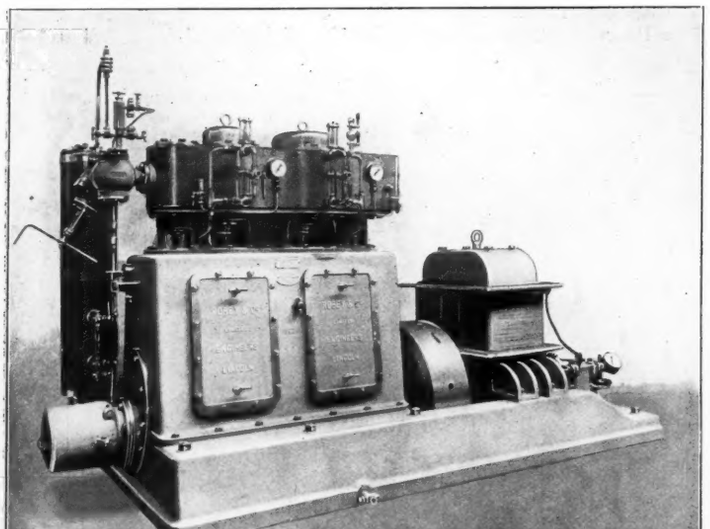
The low speed engine is of the cross-compound horizontal type, fitted with the "Richardson" automatic trip gear, the cylinders, which are jacketted, being 20 in. and 35 in. diameter × 42 in. stroke, designed to give 500 to 550 I.H.P.



Robey 550-i.h.p. Engine and Mavor & Coulson Dynamo.

as an economical load, when running at 90 revolutions per minute with 150 lbs. steam pressure. The frame of the engine is of massive construction, having bored guides for cross-heads, and four-part main bearings, lined with a special plastic metal, and fitted with side adjustment. The disc shaft is of steel, swelled in the centre to receive the fly-wheel and armature; the discs are of massive section, shrunk and keyed on the shaft, the total weight of which, with the

discs and armature, is 20 tons. The diameter of the shaft is 17¼ in. in the centre, and 12 in. at the journals, which are 24 in. long. The fly-wheel is of neat design, 16 ft. in diameter, and weighing 20 tons, and is fitted with a large



Robey Vertical Enclosed 100-i.h.p. Engine and Scott & Mountain Dynamo.

centre boss, to which the armature is bolted, thus relieving the keys from a large portion of the strain. It is proportioned to give an angular variation of ½ per cent. The steam admission is controlled by a "Richardson" mechanical and electrical governor, which automatically varies the steam admission to the high pressure cylinder from 0 to 0·60 of the stroke, according to the load, and controls the voltage of the circuit. It is so arranged that in the event of a "short" in the mains, or total cessation of the current from whatever cause, the electric regulator will stop the engine, and when used for electric driving in factories the engine can be stopped from any point by the turning of a switch. The low pressure cut-off is not varied by the governor, but is adjustable while running. Continuous lubrication is fitted to all working parts, and the plant is eminently suitable for the continuous running of heavy and variable loads, such as tramways and motor work.

The engine and generator being mounted on a massive baseplate, inexpensive foundations only are required. The steam consumption is 17 lbs. per i.h.p.-hour at full load, non-condensing, and the combined full load efficiency is 86 per cent.

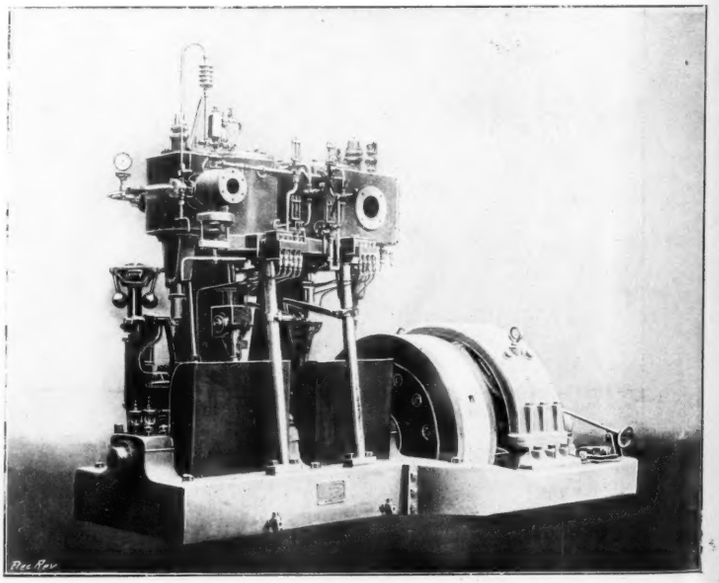
The generator, which was manufactured by Messrs. Mavor & Coulson, Limited, of Glasgow, is said to be the largest yet built in Scotland; the armature is mounted directly on the disc shaft between the bearings, and is designed to give an output of 636 amperes at 550 volts (350 kw.). The armature is of the slotted drum type, with a core built up of special charcoal iron annealed discs, insulated with varnish and keyed to a cast-iron spider. The discs are pressed together by hydraulic power, and air ducts are provided for the efficient ventilation of the core. The armature coils are of high conductivity laminated copper bars, wound on formers and insulated before being laid in the slots of the core, which are themselves lined with insulating channels. The commutator is carried on a cast-iron sleeve, which is bolted directly to the armature spider. The joints of the armature conductors with the commutator are soldered by being dipped into a trough of molten metal, thus ensuring the thorough sweating of the joints. The interior of the commutator is well ventilated.

The magnets are of high permeability cast-steel, of channel section, with tapered pole shoes bolted to the poles, which are eight in number, and of circular cross-section. The magnet coils are shunt wound, on formers detachable from the poles, and together with the armature are stove baked in dry air and treated with insulating varnish. The carbon brushes are of the reaction type, three to each set, and are mounted on a cast-iron ring supported from the magnets by brackets. The brush gear is particularly neat.

One of the vertical engines shown by Messrs. Robey & Co. is of the enclosed type, and is fitted with forced lubrication. The cylinders are 8½ in. and 14½ in. diameter × 6 in. stroke, and are designed to give 100 i.h.p. when running at 550 revolutions per minute. All working parts are of massive construction, accurately balanced, and highly finished. The oil pump is worked by an eccentric, and is fixed in a well contained in the baseplate, to which all the oil flows, the pump forcing the oil through the working parts at about 15 lbs. pressure. The engine is entirely enclosed in a massive iron casing fitted with inspection doors. The governor is of the throttle type, the high pressure cut-off being arranged for adjustment to suit the load. A piston valve is fitted to the high pressure cylinder and a slide valve to the low pressure cylinder. The base plate is in one piece, and carries both engine and generator. The fly-wheel is of heavy section to ensure steady running under varying loads.

The generator, which was constructed by Messrs. E. Scott and Mountain, Limited, Newcastle-on-Tyne, is of the two-pole undertype, shunt wound, and is rated at 200 amperes, 250 volts. The armature is of the drum type, barrel wound, forming a very neat job. Carbon brushes are used, mounted in holders after the style of copper brushes.

The remaining Robey engine is of the open front class, having easy access to all working parts. The cylinders, which are jacketted, are 10½ in. and 18¼ in. diameter × 11 in. stroke, and are designed to give 100 i.h.p. when running at 250



Robey Vertical 100-i.h.p. Open Engine and Scott & Mountain Dynamo.

revolutions per minute with 150 lbs. steam pressure. The engine is fitted with a very complete system of continuous lubrication; all the working parts are balanced, and great regularity of running is secured by the "Richardson" auto-

matic link expansion gear, which controls the admission of steam over a range from 0 to 0·75 of the stroke. Piston valves are fitted to the high pressure cylinder, and a slide valve on the low pressure cylinder. The engine is fitted with a very heavy fly-wheel of the disc pattern, to which the armature is bolted. The consumption of steam per I.H.P. per hour is 24 lbs. at full load.

The generator is of the four-pole shunt-wound type, having an output of 200 amperes at 250 volts in normal working, and was constructed by Messrs. E. Scott and Mountain, Limited. The field magnets are carried on an extended baseplate attached to the engine-bed. The armature and brushes are of similar construction to those of the two-pole dynamo last mentioned.

NOTES.

(*Continued from page* 230.)

The Nernst Lamp: a Rumour and a Contradiction.—We received the following note from a correspondent on Wednesday:—"Can you tell me whether it is true, as I hear it rumoured, that the Nernst Electric Light Company have stopped manufacturing for an indefinite period, so that greater experimental efforts may be made with a view to the improvement of the lamp?" We have made telephonic inquiries into the accuracy or otherwise of this report, and we are given to understand by an official of the company that the rumour is absolutely without foundation, and that there is no new development of any kind to record at the moment.

Cricket—Robertson v. Geeko.—The annual match between the "Robertson" Electric Lamp Cricket Club and the General Electric Company (1900), Limited, was played at Shepherd's Bush on Saturday, August 3rd. After a most exciting game the lampmakers were victorious, their score at the finish being 79, whilst their opponents made 75.

Appointments Vacant.—A shift attendant is wanted for the London Bridge sub-station of the City and South London Railway. A mains superintendent is wanted at Carlisle.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Kidderminster and District Electric Lighting and Traction Company, Limited (59,972).—This company's annual return was filed on June 5th, when 3,000 ordinary and 3,000 preference shares were taken up out of a nominal capital of £100,000 in 5,000 ordinary and 5,000 preference shares of £10 each. £10 per share has been called up, resulting in a receipt of £60,000. No mortgages or charges.

Calcutta Electric Supply Corporation, Limited (50,822).—This company's annual return was filed on May 30th, when 30,000 shares were taken up out of a nominal capital of £200,000 in 40,000 shares of £5 each; £5 per share has been called up on 20,000 and £3 per share on 10,000 shares; £133,229 10s. has been received, including £3,537 10s. paid in advance of calls. No mortgages or charges.

SUPPLY STATION ACCOUNTS.

Stafford Corporation Electricity Accounts.

The accounts for last year of the electricity department of the Stafford Corporation contain the satisfactory feature of a large increase in the output; the units sold were considerably more than doubled, but this was accompanied by a substantial decrease in the receipts per unit, and as a result the financial position shows a retrogression. A little more capital has been put into the business, and it looks as if Mr. Hubert Pooley, the new engineer and manager of the combined gas and electricity department, realised that the electricity works could be made a success without detriment to the older portion of the joint undertaking.

General Statement.

	1899.	1900.	Inc.
Total capital expenditure ...	£19,950	£24,781	£4,831
Number of units sold	86,780	200,271	113,491
Maximum load in KW.	116	171	55
No. of lamps connected	8,558	10,813	2,335
Gross revenue	£1,773	£2,479	£706
Gross expenditure...	£983	£1,871	£888
Gross profit	£790	£608	−£182
Average price per unit sold ...	4·60d.	2·91d.	−1·69d.

The units generated for the year amounted to 261,599, being an increase of 121 per cent. The equivalent of 8-C.P. lamps was 10,813, or an increase of 2,255. The revenue from energy sold has increased about 50 per cent., but taken out per unit, shows a drop of no less than 1¾d., the average price now being less than 3d. Meter rents have dwindled to an inappreciable sum, with the result that the receipts, taken together, suffer by nearly 2d. The prices charged are: lighting, 7d. for first hour and 3d. after, or uniform 5d. per unit without meter rent; power, 2½d. and 2d. per unit, while the four public lamps are charged £22 10s. each per annum.

Revenue Statement.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Sale of energy	£1,664	4·60d.	£2,430	2·91d.	−1·69d.
Meter rents	86	·24d.	3	·00d	−·24d.
Supply of lamps, &c.	—	—	28	·04d.	+·04d
Sundry rents received	23	·06d.	18	·02d.	−·04d.
Gross revenue ...	£1,773	4·90d.	£2,479	2·97d.	−1·93d.

Coal has gone up from ¼d. to over ⅜d. per unit, but this increase of over ⅛d. is wiped out by substantial reductions in the items for wages, repairs and rent, rates, &c., resulting in a diminished works cost (under 2d.) and total cost of 2¼d. The steady fall in the total cost during the last three years is a satisfactory feature of the Stafford accounts.

Cost of Production.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Coal, including unloading same	116	·32d.	£719	·86d.	+·54d.
Oil, waste, water and engine room stores	30	·08d.	67	·08d.	·00d.
Salaries and wages incurred in generation and distribution.	390	1·08d.	569	·68d.	−·40d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	214	·59d.	272	·33d.	−·26d.
Works cost ...	£750	2·07d.	£1,627	1·95d.	−·12d.
Rent, rates and taxes ..	178	·49d.	174	·21d.	−·28d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	8	·03d.	8	·01d.	−·02d.
General establishment charges, stationery and printing, law charges and insurance	47	·13d.	52	·06d.	−·07d.
Other expenses	—	—	10	·01d.	+·01d.
Total costs ...	£983	2·72d.	£1,871	2·24d.	−·48d.

The revenue increased £706, but costs by a larger figure of £888. The difference of £182 tells against the gross profit, which necessarily was reduced from £790 to £608. The financial charges for some book-keeping reason show a total of £1,154, or £10 less than in 1899. The net profit, therefore, is an increased minus quantity, and has risen from a deficit of £374 to one of £546, of which the rates were called upon to bear £500, the rest to be carried forward.

Profit Statement.

	1899.	1900.
Interest on loans	£560	£532
Sinking fund for repayments	604	622
Net profit carried forward	−374	−546
Gross profit	£790	£608

CITY NOTES.

Direct United States Cable Company.

The half-yearly meeting was held at Winchester House on 30th ult., Mr. E. M. Underdown, K.C., presiding.

In moving the adoption of the report, the Chairman said that the revenue for the past six months to June 30th, after deducting outpayments, amounted to £50,650, while the working and other expenses, exclusive of cost of cable repairs and maintenance, absorbed £21,125. The balance was £29,525, plus £5,256 brought forward; total, £34,781. The revenue showed a reduction of £1,554, as compared with the corresponding period, but having regard to the fact that additional cables had been working in the Atlantic

since the autumn of last year, that was by no means an unfavourable result. They would perhaps remember that on a former occasion he made remarks about the probability of there soon being 14 cables working across the Atlantic. They might take that to be correct, although one of the cables did not actually reach as far as America. Taking this competition into account, the result was by no means unsatisfactory, and they were following out the principle that if they and their friends were to carry on their business in the most perfect manner possible to meet the wants of the public, they had not much to fear. He was glad to say that their position to-day was no worse than it was. With regard to the working expenses, they were practically the same; stations showed small increases, but the total was only up by £311. They had made concessions to the operating staff on the long-standing question of extra payment for Sunday and holiday duty. The cable repairs this period had been somewhat higher than usual; after 27 years' working their cable had been put into a perfect state of repair, more especially that portion which was close to the Irish coast. That had been very carefully done, new pieces of cable having been laid down and the matter rearranged. Therefore, in addition to the ordinary repairs on the other side of the Atlantic, an expenditure of about £19,000 had been incurred. The chairman read the report of the cable superintendent at Halifax, which said that the cable worked and tested as well as if it had just been manufactured and laid. Investments were practically the same as last half-year; upon the whole year they had increased nominally to the extent of about £18,000. Notwithstanding the state of the market, their investments showed an increase well over their cost. The results for the whole year would be: Receipts, £101,184, less expenses, £49,151, leaving £59,233. They had paid in dividends £39,461, had placed £20,000 to reserve, and carried forward a reduced balance of £228.

The report was adopted, and resolutions declaring dividend, electing directors and auditors, and thanking the board and staff were passed.

Fleetwood and District Electric Light and Power Syndicate.

The annual ordinary meeting of the above company was held at Fleetwood on 27th ult., Mr. J. T. H. Baily presiding.

The report of the directors stated that since the completion of the installation, and up to the end of the financial year, the number of consumers had reached a total of 110, but this number had been considerably augmented during the present year. The whole of the current manufactured by the company was taken up. The directors considered the prospects favourable, and negotiations had been entered into for several important contracts. Whilst regretting that the balance-sheet showed a debit balance, the directors were not discouraged, as such could not be avoided on the first year's working.

The Chairman, in moving the adoption of the report and statement of accounts, said that it was proposed that they should make a further issue of £3,000 in debentures, making the total £10,000. This would enable them to carry out the suggestion made in the report of Mr. F. H. Medhurst, consulting engineer to the company, viz.:—"At the present time the machinery in the station is only just sufficient for dealing with the maximum load that comes upon it from time to time, and unless additional plant is provided by next winter it will be difficult to supply the full demand that will be made upon the station." It was suggested that these new debentures should be offered to present holders. Owing to the fact that money was very dear at present, they purposed offering them at 5 per cent., the new issue to run *pari passu*, and bear the same rate of interest as the present issue.

Mr. Lorrain (London) seconded the adoption.

A lengthy and acrimonious discussion ensued. Eventually it was resolved that the company be authorised to increase the capital by issuing ordinary shares or debentures at 4 per cent. Mr. Seed retired by rotation from the directorate, and was re-elected; and the business closed with a vote of thanks to the Chairman.

Great Northern and City Railway Company.

The sixth half-yearly meeting of the shareholders of this company was held on 1st inst. at the Westminster Palace Hotel, Sir Charles Scotter, J.P., in the chair.

In proposing the adoption of the report, the Chairman said the shareholders might be interested to learn that at the present time there were 526 shareholders on the register, 98 of them being foreigners. With regard to the accounts, he did not think it necessary to say anything until they became a working company. The only thing he could speak about on the present occasion was the progress of the undertaking, and he was pleased to state that the result of the work up to date was that the total length of tunnel completed was 6,659 lineal yards of 16-ft. tunnel, and 514 lineal yards of station tunnel. The work was being pushed on as rapidly as possible, and during last week, and for some considerable time, they had been employing about 1,200 men. The last paragraph in the report told them that a contract for the electrical plant and equipment would shortly be placed. They had hoped that they would have been able to have announced that day that the contract had been signed and given them the name of the contractors and other particulars in connection with the work. Unfortunately the contract had not been quite settled, but he might tell them that it would be signed in the course of a day or two, and without going into details, he might state that they intended to work the railway under what was called the multiple unit system. He was not going into detail with reference to the various systems of electrical railway working, but they knew that experience in all directions had proved that system to be the best for the particular work in connection with their traffic. They had lately had a very good object lesson in the result of the working of the Central London Railway during the last eight or nine months. Speaking from a long railway experience, he supposed it was about the only instance of a railway on a new system being opened and paying a very substantial dividend during the first six months of working. The Central London had declared a dividend of 4 per cent. upon their ordinary capital, and really they were in a position to pay more than 5 per cent., but they prudently carried a very large balance forward. He thought that was the best object lesson they could have, and they intended to take advantage of all the experience that they had gained, and they hoped to be in the position to adopt all the latest improvements, and when the line was opened they trusted its success would be quite equal to that of the Central London. No one more sincerely congratulated the Central London and its directors on its success than did he and his colleagues. There was one other subject he would like to allude to, and he touched upon it at the last meeting—he referred to the litigation with the Great Northern Railway Company. On the last occasion the matter was *sub judice*, and therefore it was not prudent for him then to go into details. It was a very peculiar action which would take a lot of explaining to a miscellaneous assembly, but it was necessary in the interests of their company that something should be settled, and he was very glad to say that the action had been settled. The agreement which gave rise to the action had mutually been cancelled by the two companies, and they were now both of them standing strictly upon their Parliamentary rights. He was certain that their Parliamentary rights in the interests of that company were infinitely better than the agreement which was made—long before he had any connection with the company—with the Great Northern Railway. The result, so far, had been that the relations between the Great Northern and themselves were never more friendly or more cordial than they were to-day. As they had to work with that company he thought that was a great point gained, and he hoped when they met again he would be able to give them more detail to show them that he was justified in stating that friendly working with the Great Northern Railway was not only to the interests of that company, but also to the interests of the Great Northern and City.

Sir Allen Sarle, J.P., seconded the motion, and the report was adopted.

General Electric Company (1900), Limited.

The first ordinary general meeting was held on 23rd ult., at the Cannon Street Hotel, Mr. Hugo Hirst presiding.

In moving the adoption of the report, the Chairman said that with regard to the balance-sheet which was before the shareholders, he could only say that if the figures were not quite in the same proportion as those they had been used to in previous years, they must remember the disturbances during the past year that had affected nearly every trade in the world, and their particular trade was no exception. They must also attribute any lesser rate of progress to the fact that the promotion of a company necessitated a large amount of work, both on the part of the directors and the staff of the company. Turning to the figures in the balance-sheet, they would notice there was an income from investments of £4,401, which was really the income derived from investments in debentures, stocks and shares amounting to £39,000. Considering they got over 10 per cent. interest, he thought they would agree that their investments were sound. Their investments were principally in kindred companies in which they had taken an interest for the further development of the business. The item of freeholds, lands and buildings was exactly the same as last year. Plant and machinery continued in the same efficient state, and during the year they had added £23,000 to that amount; considering the large sum of money which they had got from the public for the purpose of extension of the business, he did not think it would be thought a very large item. £16,000 out of that £23,000 had been spent in additions to their existing works, and only £7,000 had been expended on the new works at Witton, near Birmingham. He had just returned from Witton, and he was pleased to say that most marvellous progress had been effected there during the last few months. Their new engineering works, which they started building only just after the flotation of the company, were now nearly ready; they expected to be working in them within the next three months, and an order for a foundry had just been placed. They were both buildings 300 or 400 ft. in length, and 150 ft. in width. It was the directors' intention not only to have the most modern and the most comfortable buildings from a manufacturing point of view, but they intended to have there the very latest machinery so as to enable them to compete with anyone either in England or abroad. They felt sure, with their knowledge of the electrical business, assisted by the abilities of their workpeople, they would be able to compete with anyone. The electro-chemical works, which had recently been started, were well up, and were ready for the contractor. Their stock-in-trade was in a very similar proportion to the turnover as in the past, and he might state that they always took their stock at the lowest value. They had, in fact, produced the profits for the past year on exactly the same lines as before the flotation of the company. With respect to the item of reserve, they would notice they had put £18,000 to the reserve. The company had all along been in the habit of interesting their staff in the working of the business, and they would see that a sum of £4,864

had been set aside for a bonus to the managing directors and employés. They had already allotted 685 ordinary shares to the various members of the staff, and they would be allowed to invest more from year to year. In order to keep pace with the requirements made upon the company it had been found not only necessary to increase the turnover of every supply department, but to add a new electric traction department, from which they hoped for good results. They looked forward with confidence to the amount of work which they would be able to get to keep their new works going at Witton. He might tell them that during the past 12 months they had been successful in getting contracts for the Central Electric Supply Company, St. James's Electric Supply, Westminster Electric Supply, and just recently they had received contracts for lighting Notting Hill and Kensington, the borough of Fulham and the City of Dublin. They had also received contracts from South America, and the Indian Government had given them orders for a very important plant for utilising the waterfalls in connection with the gunpowder and ammunition works. By the removal of their engineering works from Manchester they would be able to enlarge their telephone department, and they hoped to receive a part of the municipal telephone contracts. In conclusion, he said they looked forward with confidence to the future.

Mr. Max Byng seconded the motion, and the report was unanimously adopted.

Anglo-American Telegraph Company.

Mr. Francis A. Bevan (chairman) presided on 2nd inst. over the half-yearly meeting of the proprietors of the above company, held at Winchester House, E.C., and, in moving the adoption of the report, said the directors had to congratulate the shareholders upon the result of the half-year's working. Looking at the fact that they had lost the out-going German traffic, which might fairly be put at £27,000 a year, it was satisfactory to find that the decrease in their receipts, as compared with the corresponding half of 1900, was under £4,000. No doubt that satisfactory feature was, in some measure, due to the great boom that had taken place in American stocks, but that did not last for long, and therefore they might say that the increase was spread over the whole of their receipts. They had an increase in that very uncertain item of profits earned by the *Minia*, their repairing ship, in which there was an increase of £6,255. This represented a good deal of repairing work done, and, in fact, the ship had been occupied more than usual. The work had been in every way satisfactorily carried out, and great credit was due to the captain and the crew. He was glad to say that their cables were in good working order, except as regarded one of the smallest on the other side, which might be mended any day now. At the same time they would not lose sight of the fact that the 1873 and 1874 cables were getting old, and they might reasonably assume that the oftener they lifted the cables for repairs, the less likely would they be able to lift them the next time. He only mentioned that in connection with the renewal fund, which was very often attacked at those meetings. They must bear in mind that they had to carry out a good many repairs, and they had two rather old cables, and he hoped they would support the board in their policy of maintaining their renewal fund, which might at any time be considerably depleted if they had to lay one or two cables. On the other side there was an increase in expenses of £4,195, chiefly accounted for by three items. The first was an increase in salaries. That was a matter almost beyond their control, because they had many competitors, and the Government paid high salaries, and if they were to keep good and efficient men, on which the successful working of the company depended, they must pay their staff good salaries. They had also had to pay a little more for instruments which required renewing, and they had an item of advertising which cost £600. That was carried out on the other side by their partners, the Western Union. They (the Western Union) thought it necessary to go in for a rather large advertising business, and asked them to join in, and they consented to give £600 towards the advertising, which he hoped had come back in the shape of increased traffic. The result of all of it was, to reduce the amount for dividend by £2,366, and they carried that amount less forward. He might allude to the large sums of sundry debtors and sundry creditors in the accounts. That was quite accidental, but they always were owed a great deal of money, and always owed a good deal. The debts, were, however, perfectly good, as the Government itself was their chief debtor. In conclusion, the chairman alluded to the Pekin case, in which he said progress had at last been made. During the present week the Court at Rouen had given a decision to the effect that the Pouyer Quertier Company should pay their company a first instalment of 1 million francs, with interest. That was a first instalment of a much larger sum they one day hoped to get. That decision had been appealed against, and would go to the Court of Cassation, but if the company succeeded in that Court, it was positively the last thing that could happen. He thought the result justified the board in having persevered year after year.

Mr. Burt seconded the motion, and it was agreed to.

Charing Cross and Strand Electricity Supply Corporation.—On July 24th the directors, after providing for debenture and other interest and dividend on preference shares, declared an interim dividend at the rate of 8 per cent. per annum for the half-year ended June 30th, 1901, and carry forward £11,890. The registers for the preference and ordinary shares will be closed for the payment of dividends from August 7th to August 17th, 1901.

Crompton & Co., Limited.

Mr. John Trotter (chairman) presided on 1st inst. at Winchester House over the annual general meeting of the above company.

In moving the adoption of the report, the Chairman said he could congratulate them on another successful year, although at first sight the success which had attended their efforts did not seem to be reflected in the accounts. The gross profit of £68,633 was very similar to the gross profit of last year, which was £66,891. But they knew they had done more business and employed more men, and had made no bad debts of any serious nature, and therefore at first sight it did seem disappointing that with little more profit there was a very considerable increase in the expenses. They were prepared for a slight increase on account of the price of coal, and also from the fact that the salaries of the staff had been increased. However, they had to consider the increase of expenses in connection with a very large figure in the balance-sheet, viz., "Stock-in-trade and work in progress," £141,232, as compared with £95,459 last year, which was an increase of £46,000. Although they could strike a balance of their accounts on a certain date, it was impossible to close the contracts, and that year they had a large amount of contract work which was not completed. The policy adopted by the board was to take into account no estimated profits on uncompleted contracts. There was not a single farthing of profit taken into the accounts before them on work in progress, and consequently that was reflected in the accounts. It must be remembered that it would come into future accounts, and was only postponed profit. That accounted for the increase in the expenses, although taking actual work done the gross expenses were slightly down. Depreciation of plant and machinery was rather less, simply because they had written so much off in previous years. The net profit was £27,000, as against £31,000, and they proposed to pay a dividend at the rate of 9 per cent. for the six months, to write off practically the whole of the patent accounts, reducing it to £10, to carry forward £3,143, and provide £2,500 for bad and doubtful debts. Inasmuch as their debts had only amounted in the past year to £500, he thought they had made ample provision for the coming year. Proceeding to deal with other figures in the accounts the chairman pointed out that they had invested £6,000 of the reserve fund outside the business, and it was their purpose in due time to invest more of it outside the business. The plant, tools, &c., showed an increase of £7,000. They had been buying all the latest tools they could get, for they felt that competition was growing stronger in the trade, and they intended to do all possible to provide the best machinery they could find either in the old world or the new, so as to be level with their competitors, and be able to manufacture at the cheapest possible price. Referring to the stock-in-trade and work in progress, the chairman said the board did not like to hold much manufactured stock, and they had adhered to that policy in spite of pressure from their managers, whom they were always urging to turn out work quicker and quicker. Their managers impressed on them that if they could hold a larger stock it would act as a buffer between them and the demands of the business, but the board felt that the balance was against holding large stocks, for in a short time a large stock might become obsolete. The manufactured stock, therefore, was about the same as last year, but there was an increase of £6,000 in the raw material they held, which was necessary on account of the greater number of men employed. They had adopted the most stringent measures to satisfy themselves that the stock was what it was represented to be, and with regard to their running contracts they were satisfied that without a single exception they were likely to realise a profit in due course. Coming to the Chelmsford Electric Lighting Company, there had been an increase in that item from £38,600 to £43,400, but he was happy to say that they had practically completed what they had been trying to do for a considerable number of years—viz., to absolutely start the concern on its own basis, and separate it completely from the works of Crompton & Co. The question was whether the money spent had been too great. The capacity of the Electric Light Company was 1,651 kw., and he had taken the figures of eight companies of a similar capacity and compared them. The result was that whereas the capital expenditure per kilowatt for Chelmsford was £74, the average for the eight companies was £104. The average expenditure for the eight companies per lamp was £3 9s. 7d., and the expenditure of Chelmsford had been £3 4s. The expenditure had resulted in a considerable expansion of business, and he looked for a further increase that year, and also for satisfactory profits. In conclusion, he pointed out that in four years they had reduced the item for patents in the balance-sheet from £13,400 to £10; had entirely wiped out the cooking and heating item, and had reduced the item for goodwill from £30,000 to £10,000. He hoped some day to wipe the last item out altogether.

Lieut.-Col. Crompton, in seconding the motion, referred with satisfaction to the way in which he found the affairs of the company carried on during his absence in South Africa. He had read about the decadence of English manufacturing supremacy, but a recent visit to Germany had convinced him that Crompton's had nothing to learn either as to the German methods of work, or the way they treated their employés. The report was adopted.

Edison and Swan United Electric Light Company.

Major Flood Page presided at the eighteenth ordinary general meeting of this company, held last Friday at Cannon Street Hotel. The notice convening the meeting having been read by Mr. Gover (secretary and general manager),

The Chairman said that the report had been circulated, and unless any shareholder wished it read they would take it as read. (A

Shareholder: Had enough of it!) He was sure that every proprietor in the room regretted very much indeed that Mr. Forbes, who had been the chairman and had presided over every meeting since the institution of the company, was not there to preside——

Colonel Stroud: May I ask whether he is in this building now and presiding at the Chatham and Dover Railway meeting?

The Chairman said that Mr. Forbes had written a letter, which had been received since they arrived in the building, expressing his regret that he was in another room presiding at another meeting. Major Page said that he was sure that if the shareholders regretted it, there was nobody in the room who had anything like as much cause for regret as he had. He was presiding at the earnest request of his colleagues. They were a headless body, and his position was one, of course, in which he could not speak to them with the authority of a chairman; and, moreover, at the end of the meeting, he would no longer be a member of the board. (Cries of "Hear! hear!!") He therefore asked that they would endeavour to place themselves in his position—a man undertaking a task which did not fall within the range of his ordinary duties—and he asked for such consideration and forbearance as they were able to give him. Taking the report according to the sections, No. 1 spoke for itself, No. 2 simply showed the amount of money carried to net revenue, and that nearly the whole of it had been absorbed in payment of interest and debenture stock. Then they came to Clause 3, which they had probably read. It was just the ordinary position in which most companies, or many companies, were at that moment involved. They (the board) stated that competition had been very keen, that prices had been higher, that business had been smaller—hence the difficulty, the fact that the revenue was diminished. Since the expiry of their patents great competition at greatly reduced prices had been going on. There had been a constant change in the article which they had had to manufacture. The engineers forced upon the lamp makers without due consideration the change from low to high voltage, and high-voltage lamps were much more difficult and expensive to make, and did not last so long; and other improvements in holders and fittings and other things had made the position of the company extremely difficult. He was, however, glad to be able to state that they had very greatly improved the high-voltage lamp. They had two factories working, the one at Newcastle and the other at Ponder's End, practically in competition, and the result was that they had a cheaper and better lamp. Now, in addition to that loss on trade, they had been in a transition state in the fittings department which had rendered it very difficult, changing over from one manager to another. The profit and loss account showed that the trade last year was £285,667, whereas this year it had been only £235,433. That was a very serious loss in trade, but those who went back and examined the fluctuations of the business of the company could hardly be surprised. He had taken out of former balance-sheets the fluctuations which took place a few years ago, just at the expiration of the patents. In 1893 the sales of lamps and fittings amounted to £183,641; in 1894 they fell to £131,250; in 1895 they again fell to £114,890, so that in two years there was a loss in trade of £68,751. The trade went up again a little in 1896 to £128,101, and in 1897 it improved a little more, but even then it was some thousands of pounds below what it had been five years previous. The moral to draw from that was, first, that the fluctuation had proved to be common, they were accustomed to it, and in addition to that they had recovered the business, and he firmly and strongly believed that they would recover it again. The public had not lost faith in the name, nor in Mr. Swan (hear! hear!!) personally. Mr. Swan would directly tell them of improvements which he was going to make. They had begun the year well in this way: for a long time past they had been passed over by the Admiralty, because of price, but recently they sent the company an urgent order for 100,000 lamps, and asked how many they could deliver. They were probably the only company in the world who could have delivered immediately—they did not use the ordinary lamp—15,000 were delivered immediately, and they got the order for 100,000. From that fact he asked them to draw that there were certain changes which they had to make, and when the board was reconstituted they would find that a great deal of work had been under consideration already which they would have to deal with—changes in price and cost of distribution. Of necessity that had been postponed, but he wanted them to take to heart that he believed it to be absolutely and literally true that there was no reason for despair nor for alarm. They had gone through it before and recovered, and they were sure that they would do it again. In regard to Clause 4, at the last meeting of shareholders the chairman announced that a new manager had been appointed to the fittings department, and Mr. Forbes spoke as follows:—"Our fittings business is developing rapidly and has outgrown the machinery ready for it, and I am not sure that it has not already outgrown the brains that have conducted it. We have reconstituted the whole affair, and under an engineer of ability and reputation; he has accepted the office with a declaration that he is perfectly satisfied that this is a business out of which we may make very large profits in future." When that gentleman got to work—although Mr. Forbes announced it at the last meeting, Mr. Joyce, the gentleman in question, did not take the position for some months afterwards—he found the fittings factory not at all in good order. He devoted a long time towards trying to get it into order, and after frequent meetings with the directors, he overhauled and examined the whole stock, stores, and everything that was in that factory, and during that investigation, to their immense surprise, he found that in the past, work which had been completed, was carried forward as work in hand, and as a good asset. He would ask them to deal with the amount later on. They would find it written on the other side of the account that the work came to £14,772, which ought to have appeared in previous accounts, from which it was excluded. Clause 6 referred to the time when the company absorbed the Manchester Edison & Swan Company and took over the Broadheath factory. It was a very small business when they took it over. They tried to develop it, and could not make a profit on it. It was mixed up with the Altrincham Company, and was under the same roof. They came to the conclusion that it ought to be closed. It was an inheritance which they received from the Manchester Company. They were obliged to absorb the Manchester Company, for it had the right to use their name and manufacture lamps, and might have put its name on lamps which were not this company's at all, and sold them as Edison & Swan lamps. It was a matter of absolute necessity that it should be absorbed, or it would have cut into their lamp business. The chairman then read Clauses 5 and 7, and discussed them together. No shareholder could have been more astonished than the directors were when they found those facts. As soon as they found them, without concealment, without hiding anything, they had revealed them to the shareholders in their full nakedness. Shareholders asked how it came about. He could only say this. If they would only refer to the chairman's speech of last year again they would find that he spoke as follows:—He referred to the very large number of articles that were made in their factories, amounting to five, six or seven millions a year, and he said: "Our business is one made up of very small elements, but coming up in the aggregate to a very serious matter in respect to the stock we have on hand. We came to the conclusion that we should close the year, after a stocktaking in the month of June, of a more serious nature than heretofore, which would put us into something like absolute knowledge as to whether the stock was of the extent and value shown in the books. . . . . I may remark that we have ascertained since the accounts were stated that the stock is really £6,000 at least more valuable than it is credited as being." The chairman (Mr. Forbes) went on and said that it made one anxious when such a large sum was carried forward represented by an enormous variety of articles more or less purchaseable, but so far as human intelligence and application could help them, he thought he could assure them that that was a sound asset. Major Page said he did not believe there was a single person in the world who disbelieved Mr. Forbes when he stated that was the result. That he was justified, he (the speaker) would show the care Mr. Forbes had taken in the matter (laughter). Quoting again: "The auditors have been consulted in this matter, and have always taken a great part in it, and you will see that we are acting in accordance with them. We have, however, taken stock, and we have every reason to believe that the account is well within the saleable value, &c." That the board had now found out otherwise, and told the shareholders, was probably their chief fault (laughter, and "Ought to have been found out before!"). Well, all he could say was, when they had a chairman of the company, who had been chairman from the commencement, one of the best known men in London, all he could say was that they could not go behind him. They had found this out, and they had revealed it to Mr. Forbes, and they could only express their intense regret that it was so, but it was not possible for them to alter the figures. The figures remained, and it was a fortunate thing that they had reserve sufficient to deal with the position. The chairman proceeded to enter into various other matters, when he was interrupted by

Mr. Lea Smith, who objected to so much time being taken up by a lengthy speech. The report was bad; they could not make it any better. He wanted to know what they proposed for the future. His remarks were received with mixed feelings of approval and dissent from other shareholders, but

The Chairman said that the shareholders were entitled to know. However, he would not go into these other figures, but would come to the last expression in the report, which was that the directors had placed before the shareholders fully and unreservedly the result of the special examination which had occupied them for several months. In expressing their sincere regret at those unexpected results, they said that they were of opinion that the business, if properly conducted, was good, and there was every reason for believing that changes would set matters right again. He had already told them of the fluctuations that had existed in the business. Now he went on to say that the new directors would find that much progress had been made towards certain changes in policy and organisation which had been delayed pending their joining the board and taking them into consideration. It was hardly for him to dwell upon the future, but what he could tell them with reference to the past was that in the year 1884, when the company was constituted, the assets of the company were placed down as £75,000, plus the patents. They now stand on the books at over £550,000, and they had distributed over £528,000 in dividends. They had distributed to the shareholders too much money. If they had, instead of distributing £528,000 to the shareholders, crowded into very short period—because the first five years there was no dividend at all—they would have put more to reserve, and to-day this would have been a much less important thing. This he was confident of, that if the cost of manufacture and distribution was reduced—it was well within the range of possibility—it would lead to very large sales. He believed that with the reductions and changes the company was in a sounder position than it had been for years. He declined to acknowledge in any way that the company was a failure. Its record was good. (A Voice: "By good management!") What were the board responsible for? If they wanted to know where they had failed, it was that they were responsible for the selection of the men who had to carry out the work, and there they had failed. They confessed that they had failed there. After that, he left the board with the feeling that

the company was in a sound state. The directors held between them very nearly £50,000. No director had ever sold a share. He was not going to part with his shares now. He then formally moved the adoption of the report.

Mr. J. Wilson Swan, F.R.S., rising to second the motion, said he thought it was not necessary for him to say anything further as to the report itself. Major Page had gone very fully into that, and explained how it was that such an unsatisfactory record of the year's working had to be presented to them, but he did feel that he could endorse all that has been said as to the essential soundness of the company. There was every reason to hope that "with good management" the company could be carried on in a highly profitable way. The part that he himself had taken in the company's affairs had been somewhat exceptional. He had taken chiefly a technical part in connection with the lamp manufactory. Of course he also shared with the other directors full responsibility for the general management, but beyond that he had had additional responsibility thrown upon him in the technical department. He had tried, and he was sure not quite unsuccessfully, to improve and cheapen the lamp. At this moment there were being carried out several very important improvements, which would have the effect of further reducing materially the cost price of the lamp and at the same time of greatly improving its efficiency, therefore their power of expanding their business so far as lamp manufacturing went was on the point of being greatly increased. That result was anticipated with much confidence—so much, in fact, that already extensive preparations had been made to enable increased demand to be promptly met. He expected that they would improve their position by those changes, and more especially in connection with the high-voltage lamp referred to by Major Page. As to lamps of high voltage, there had been some question as to the quality of their efficiency as compared with low-voltage lamps. There was recently a Board of Trade inquiry at which the question was raised. That inquiry was attended with conflicting evidence. Whatever the changes might be, it was certain that when the improvements had been carried out there would no longer be any question as to the high-voltage lamps being fully equal in efficiency to lamps of lower voltage. As a result of those improvements and extensions of the works, they had a full right to expect a large increase in the most profitable branch of their business.

Col. Stroud asked whether the auditors went over the stock-in-trade, which was the life or death of a company like this. He maintained that the dealing with the Altrincham Company, which had £40,000 "A" shares in 1898, was a dead loss to this company. That company had a seat on the Ediswan board. It was given to a very clever man, he believed; he was very ill, but was he alive still? The auditors might say that they had nothing to do with such affairs as the company had experienced, but judges had ruled otherwise. The loss of the company was through the directors being supine. The word "supine" in Latin meant "lying on your back and looking up to the stars." If that was so he could not wonder at the loss of £110,000 to £120,000.

Mr. Lea Smith said that the very worst point in the whole balance-sheet had not been brought out at all in the chairman's speech. Here, for the first time, they were told that they owed this company £20,000 for goods. There were debentures since 1899, and for the first time they heard something about it from the auditors who said that the interest was still outstanding. There was not a word about that in the report. That was the worst point in the whole thing. He had great confidence in the Ediswan Company. He was glad that Mr. Swan had such a reception, and he deeply regretted his position. Directors when they came on to a company like this ought to work. He would like to know how many times Mr. Forbes had been to the factories. He was the best chairman for a public meeting that he had ever met, but he was not a hard working business man. The past ought to be buried, but he thought they ought to have good sound business men on the board, and he hoped that if those remaining were not so, that they would yet retire.

Mr. Satchell said that the dividend declared in March ought never to have been paid. He referred to the careless management of the company. He had been a business man for over 50 years, and was accustomed to take stock. If he took stock one year and found a mistake of thousands of pounds, he should blame himself or those under him. He thought that the directors could not have properly looked into the matter of the value of the stock. There were two gentlemen proposed to come on to the board. Had they any knowledge of the business, or were they merely guinea pigs? What did they propose to do? What remuneration had the directors received for their mis-direction? The accounts lumped the amount with other items. He paid £3 for his shares, which were now worth 10s. or less.

Mr. Lorrain asked whether, when the directors paid the March dividend, they were aware that they were not earning it?

The Chairman, replying to Mr. Lea Smith's reference to the Altrincham Company, said that the position was as follows:—The Ediswan Company inherited that company; it owned the greater part of it. The directors of both companies were the same. Since the report had been printed there had been a further issue of debentures, making a total of £25,000. It was quite true that goods supplied had not been paid for in cash, but the goods, plus the interest that had not been paid, amounted to £20,000. Acting under the solicitor's advice, it was intended almost directly to issue more shares and a corresponding number of debentures, so that that company would hold then £32,000 in debentures in addition to the £23,000 shares. They believed that to be an admirably good asset. The company had turned the corner, and was paying a small profit. £32,000 4 per cent. debentures in the Altrincham Company was a gilt-edged security which could be easily realised. It would have been realised earlier but for the rise in coal. With reference to the attendances of the board, there had been 32 board and committee meetings since January last, and they had been working just as hard as if it had been their own private business. The stocks had not come up to the value placed upon them, but when they said that the directors were responsible for that, they might not have seen one of the most important judgments ever delivered in the House of Lords in that day's *Times*. It said that directors were entitled to rest in the belief that those they were employing were doing their work properly. They were not expected to turn themselves into auditors or go down to the factories to see that the work——

Mr. Lea Smith: But you said just now that you had failed because you had not got the proper people to work for you!

The Chairman, continuing, said that those who knew the qualifications of the gentlemen coming forward for election would speak as to that point.

Mr. Lorrain, referring to statements which had appeared in the electrical press to the effect that this state of affairs had been common property for some time past, said it was clear from the fall in the shares that it had been known.

The Chairman said that shareholders holding a fourth of the "A" shares formed themselves into a committee, and asked the board to have an extraordinary meeting. The directors thought it better to wait until the annual meeting. The deputation asked for certain seats on the board, and he ventured to suggest that it was not desirable to have a committee, as one-fourth of the shareholders of the company already constituted such committee.

At this point the adoption of the report was put to the meeting and carried, but many shareholders did not appear to observe that the motion was put at all until they found it had been passed.

Mr. Cole spoke as to the work of the committee. About three months ago they saw the thing was going from bad to worse, and that it was time to stop it. He did not know what things would have been by this time if they had not come in then and stopped it. The committee had not sold a single share. The speaker then explained that the two new directors were men of great business capacity. Mr. Wolfenden was a large Lancashire manufacturer who had made his fortune, and his business was one of the companies taken over by the Fine Cotton Spinners' Association. He had had large experience with different companies where machinery and factories were the predominant feature. Mr. Ellice Clark three years ago took the chairmanship of a company with a loss of £9,000 to £10,000. Last year it showed a profit of £6,500.

Mr. Lorrain said that the general opinion of the electrical profession was that as long as the company remained in the present hands, it was impossible to do any good.

The two new directors were then unanimously elected.

A discussion now arose as to the re-election of the auditors, and many shareholders gave unmistakable signs of desiring a change, but after the meeting had heard brief statements made by Mr. Lea Smith and Mr. Welton (the auditor), the firm of Welton, Jones and Co. was re-elected with only two dissentients. It was said that the articles required the auditors to accept the statements of managers as to stock, and Mr. Welton said that as auditors it was not their duty for the fee paid, to go down to the factories and examine and value all the stock. Mr. Lea Smith thought that in future the auditors should protect themselves by saying that the stock valuation was accepted on the certificate of the officials.

The meeting broke up without the usual courtesies.

The Metropolitan Railway Company and Electric Traction.

The half-yearly meeting of the shareholders of the Metropolitan Railway Company was held on 26th ult. at the Cannon Street Hotel, when Col. Mellor, who presided in the absence, through illness, of the chairman of the company, Mr. Bell, devoted a considerable portion of his speech in proposing the adoption of the report, to the question of electric traction. After stating that the opening of the Central London Railway had last half-year taken away £42,000 worth of traffic from them, he said that, as business men, the directors recognised that, under the circumstances, they must set their house in order, and that quickly, in order to meet the competition with which they were faced. They all recognised that it was in the direction of electric traction that they had to look for the restoration of the traffic and of the earning capacity of the railway. It was there they had been attacked as though they were the obstacle and the hindrance to the immediate prosecution of that most important work. They were the last people who should have been blamed for the delay. No body of men could have been more anxious to push forward that work. They felt strongly how their property was being injured by the Central London. Their neighbours and partners in adversity, the District Company, were as anxious as they were about this matter. They were being hit, though not so severely as they were, by the Central London competition. They were united together hand and glove in their determination to push the business through. They each appointed an electrical engineer as their advising expert. They appointed Mr. Thomas Parker, the electrical engineer who planned and constructed the Liverpool Overhead Railway, which had been from the first a most successful electric railway. The District Company appointed Sir William Preece, until lately the Government electrician of the Post and Telegraph Departments. These gentlemen drew up a skeleton specification, and they advertised for tenders. They had nine tenders sent in from the most eminent electrical engineering firms in the United Kingdom, on the Con-

tinent, and in America. Those tenders were submitted to a searching examination by their experts, and they reported that the tender of one firm, that of Messrs. Ganz & Co., of Buda-Pesth, stood out from all the rest by reason of its combined simplicity and economy. They considered that so important, that they despatched the two electrical engineers to make a thorough examination of the system on the spot, and report upon it fully. They did so, and their report was entirely favourable. It was evident from the report that the Ganz system possessed features of such novelty and importance, that it amounted practically to a new departure in electric traction. He ought to have mentioned that at the commencement of their negotiations in the business they appointed a Joint Electrical Traction Committee, representing the two companies, and so satisfied were the Committee with that report, that they passed a resolution recommending their respective boards to address a joint letter to Messrs. Ganz & Co., accepting their tender, subject to the approval of their system by the Board of Trade, and to certain other conditions to be formulated by their electrical advisers. Eventually, in the month of March last, a joint letter was agreed upon by the boards of the two companies, and sent to Ganz & Co., as stated in the report. Up to that time the two companies had worked together in perfect harmony for the prosecution of the object they both had at heart. But about that time a new influence appeared to be at work in the Councils of the District Company. A group of American capitalists, with Mr. Yerkes, of Chicago, at their head, came forward and offered to find a million sterling, if a new company, to be called the "District Electric Traction Company," might have the contract for equipping the District Company with its electric installation. They were asked to and did meet those gentlemen with the chairman of the District Company, but that meeting came to an end, after some discussion, in consequence of a statement being made by them that they would not have the Ganz system on any consideration, and further than that when they were before the Committee of the House of Commons two or three weeks ago, Mr. Yerkes told the Committee "he would not put a dollar in the Ganz system." What were they to think of the mental attitude of men who professed to be leaders in scientific and industrial progress, who could express themselves in these narrow and contemptuous terms of a system which the distinguished electrical engineers of the two companies declared to be in advance of any system of electric traction at present existing either in this country or in America? He (Col. Mellor) asked the House of Commons' Committee, when giving his evidence, what would be thought of a man who in these days came before them and said that because he was transmitting telegraphic messages successfully by means of wire, "on no consideration" would he listen to a proposal for wireless telegraphy. He said then, and he ventured to tell that meeting, that it was idle to attempt to arrest the progress of electrical discoveries and inventions. If that new method of Messrs. Ganz & Co. was what their experts say it was, then it was destined to render valueless millions of dollars' worth of electrical plant both in this country, and especially in America, and there were not wanting signs that a determined effort would be made by interested companies who commanded immense wealth to stifle and strangle this new departure in electrical engineering. At a meeting of the Joint Traction Committee held on April 25th, Mr. Forbes mentioned for the first time that his company had decided not to use the Ganz system outside the Circle, that he was only committed to the Ganz system so far as the Inner Circle was concerned, that he considered he had a perfectly free hand as to the system they should adopt outside the Circle, and further, and that was the crux of the whole matter, whatever system he used outside the Circle he should certainly continue over his portion of the Circle so as to extend it continuously to the Mansion House. He begged them to mark the effect of that. The Circle was 13 miles in length. Of that the Metropolitan Company owned seven, the District four miles, and the remaining two miles were joint property. If Mr. Forbes took his American system over his four miles, he made it absolutely impossible for them to apply the Ganz system over the other part of the Circle, because they must have one and the same system all over the Circle. It was that they protested against. He could not tell them how much he and his colleagues on the Metropolitan Board deplored that action of the District Company. They had been getting on so well with them, working in such complete harmony with them for the rapid prosecution of that most important enterprise, that this announcement of the change of front on the part of the District Company—for it amounted to no less—came upon them like a bolt from the blue. They did all they could to induce them to stay their hand. They pointed out the effect it would have in preventing both of them from keeping faith with the public, and he himself pointed out that both the electrical engineers adhered to every word in their report. They even offered to do what they could to assist the District Company to raise the necessary funds, independent of this American combination. But it was all of no use, and when they applied to Parliament for powers to force their system upon them they felt bound to oppose them. He was careful to tell the Parliamentary Committee that they had not the slightest wish to defeat the District Bill, all they asked was that they should not be compelled to adopt a system, of which they knew nothing, when they were practically committed to a system which the District Company's engineer, as well as the Metropolitan, had told them was the best and was the most advanced which had yet come before the public. He asked for an independent tribunal which should inquire into and settle the system which should be adopted by both companies, and that tribunal, he was glad to say, they had got. He wished them to distinctly understand that that board had no interest, direct or indirect, in the Ganz system. He asked, as a man of business and commonsense appealing to men of business and commonsense, were they right or wrong in seeking to get an authoritative decision as to the merits of the two systems? To that question there could only be one answer. There was another most important factor in that business which materially concerned the shareholders and demanded their careful consideration, and it was a factor, he need scarcely say, which had received the anxious and careful consideration of their board—he meant the cost of the installation. The Ganz system required no sub-stations with moving machinery, thereby saving about £150,000 in capital outlay, and about £10,000 a year in annual up-keep. In fact, they were advised that the total cost of the Ganz system would be at least 30 to 40 per cent. less than that of the American Syndicate. Whatever the decision of the tribunal might be, they should loyally accept it, and at once go to work with their neighbour to carry it into effect, and he hoped and trusted that they would do the same. In the meantime they were proceeding with their power house at Neasden, so little or no further delay need ensue.

The report was adopted.

Central London Railway Company.

THE report of the directors for the half-year ended June 30th last, submitted to the meeting held yesterday, 8th inst. (our account of which is held over), states that the amount expended on capital account was £22,576. The revenue receipts from all sources amounted to £164,823. The working expenses amounted to £90,267, being 54·77 per cent. of the receipts, leaving a balance of £74,556. The traffic has made steady and satisfactory progress during the half-year, the average earnings per train mile being 5s. 1·28d., as compared with 4s. 10·28d. in the previous five months, whilst the working expenses were ·35d. per train mile less than previously. The number of passengers carried since the opening of the railway is as follows:—Five months ending December 31st, 1900, 14,916,922; half-year ending June 30th, 1901, 20,285,739—the total number carried being 35,302,661. Including the balance of £3,527 brought forward, the net revenue account shows a total of £79,497, and after providing for interest on the debenture stock, there remains an available balance of £65,533. The directors recommend that out of this sum an interim dividend of 4 per cent. per annum be declared at the following rates of distribution:—Undivided ordinary stock at the rate of 4 per cent. per annum, preferred ordinary stock at the rate of 4 per cent. per annum. The result of the half-year's working is sufficient to pay dividend at the rate of 4 per cent. per annum on all classes of capital stock, but, under the company's Acts, the dividend on the deferred ordinary stock is not payable until the result of the working of the year ending December 31st has been ascertained. It is, therefore, proposed that a sum of £9,899, part of the general balance of £18,432, should be carried to a dividend suspense account (divided stock), which will be dealt with at the end of the year. The company's Bill, which was approved by the proprictors at the special meeting held on February 13th last, has been divided into two Bills—(No. 1) providing for an extension of the line to Liverpool Street, with a loop at that point and at Shepherd's Bush, and to authorise the raising of £400,000 share capital with the usual borrowing powers; (No. 2) providing for the acquisition of land to enable the company to construct additional lifts at Shepherd's Bush Station, also to authorise the raising of £150,000 share capital, with borrowing powers. No. 1 Bill has been before the Joint Committee of both Houses of Parliament on Underground Railways, who have recently issued their report. This Bill will not be proceeded with this session, but No. 2 Bill is unopposed, and is now waiting the Royal assent. The Committee appointed by the Board of Trade to inquire into the complaints as to vibration, have taken evidence, and are now waiting the result of experiments about to be made by the company before making their final report. Of the company's 4 per cent. debenture stock, amounting to £876,000, the sum of £698,201 has been issued, including the amount due to the Electric Traction Company under the terms of their contract. In accordance with the resolution of the proprietors passed at the special meeting held on February 13th last, the company's shares were converted into stock as from June 14th last, and the various stocks are now quoted on the Stock Exchange. With regard to the service of electric trams between Shepherd's Bush, Kew Bridge and Acton, and the extensions to Southall and Hounslow, the directors state that there is little doubt that the improved facilities thus afforded will largely increase the traffic of this company's railway. The auditors' certificate contains the following:—"Having regard to the machinery employed in the working of the railway, it will be desirable at end of this year to establish a fund for depreciation of working stock, machinery and permanent way."

La Capital Traction and Electric Company, Buenos Ayres.

THE report for the year 1900 shows a balance of profit amounting to £18,321, which represents the profit of the Traction Company derived from the direct working of the lines of the La Capital Tramways Company, Limited. The Cordoba Light and Power Company's accounts show a balance of profit available for dividend amounting to £11,738 (of which £8,547 corresponds to the year 1900, and the remainder was brought forward from 1899). As the Traction Company owns all but 3 per cent. of the preference stock of the Cordoba Company, and the full dividend on that stock requires £12,000, more than £11,000 of the balance stated above corresponds to the Traction Company's holding, which would make the total available for dividends up to £29,500. The balances of profit for 1900 have been arrived at after writing off from pre-

liminary expenses and expenditure on supervision of construction, and in connection with the purchase of materials required for construction, sums amounting to £3,031 from the Traction Company's earnings, and £486 from the earnings of the Cordoba Company. The La Capital Tramways Company's accounts show a balance of profit brought forward from 1899 amounting to £13,528, which, with a sum of £515 realised from the horse renewal fund in 1900, makes a total of £14,043. The directors recommend the payment of the 5 per cent. cumulative dividend (less tax) on the preferred shares from date of issue to September 30th, 1900.

British Columbia Electric Railway Company.

The report for the year to March 31st last states that for the purpose of raising funds to meet liabilities already incurred, and to provide for further extensions and improvements, the balance of the unissued preference share capital of the company—viz., 6,400 preference shares of £10 each—was recently offered for subscription. The shares were all applied for, and were allotted on May 3rd, 1901, since which date they have been fully paid up. The gross receipts for the year were $496,796, showing an increase over the preceding year of $46,174; the working expenses were $297,565, an increase of $43,445; the net earnings being $199,231, or $2,729 in excess of last year. The net profit for the year, after deducting London office expenditure, was £37,553, including £132 brought forward. After meeting debenture interest and the interim dividends, the sum of £19,103 was available for distribution and reserves. The directors have decided to write £1,218 off preliminary expenses, to recommend a final dividend on the ordinary shares of 2 per cent., making 4 per cent. for the year, and to transfer £5,000 to capital amortization account, and £5,000 to reserve for depreciation, carrying forward £64.

Chili Telephone Company.

The directors' report to March 31st, 1901, reads as follows:—

The board submits to the shareholders its twelfth annual report and accounts of the company to March 31st, 1901, duly audited. The aggregate number of subscribers at all centres at the end of the year was 4,723 as compared with 4,613 at the beginning, or a gain of 110 for the year. The gross revenue in Chili from all sources was:—

In 1900-1901	$683,170
In 1899-1900	651,436
An increase of	$31,734

The expenditure in Chili was:—

In 1900-1901	$347,413
In 1899-1900	364,549
A decrease of	$17,136

The net income in Chili from all sources was:—

In 1900-1901	$335,757
In 1899-1900	286,887
An increase of	$48,870

The average rate of exchange for the year was 16·65d., as compared with 15·17d. in the previous year, giving an increase for the year of 1·48d. Converted into sterling at these rates, the figures given in the preceding paragraph are:—

In 1900-1901	£23,290
In 1899-1900	18,130
An increase of	£5,160

The liquid assets and liabilities in Chili on March 31st, 1901, were valued at 17d., the current rate of exchange on that day, as compared with 16¼d. at which they were valued on the corresponding date of the previous year. The increase in the value of the liquid assets over liabilities in Chili due to this rise in exchange amounts to £800, which has been carried to reserve. The balance to the credit of the revenue account, including £1,003 brought from the previous year, is £18,879, of which £5,199 has been carried to reserve for depreciation and renewals. The directors recommend the payment of a dividend of 5s. per share, free of income-tax, being at the rate of 5 per cent. per annum, absorbing £11,000 and leaving a balance of £2,680 to be carried forward. During the year the capital outlay in sterling was £488, and the total mileage was:—

	Miles.	Yds.
On March 31st, 1901	8,591	518
On March 31st, 1900	8,298	890
An increase of	292	1,318

In accordance with the articles of association, Mr. Frank W. Jones retires from the board of directors, and being eligible, offers himself for re-election. The auditor, Mr. Thomas A. Welton, also retires and offers himself for re-election.

The twelfth ordinary general meeting of the proprietors of this company was held on 2nd inst. at Winchester House, Mr. George Keith presiding.

In proposing the adoption of the report, the Chairman said the business of the company during the past year had been working very favourably, and the figures shown in the balance-sheet were a good improvement on those of the preceding year, and he thought they were the best the directors had ever been able to place before them. The gross revenue for Chili for the year amounted to $683,170, showing an increase of $31,734. The total expenditure reached $347,413, a decrease of $17,136. During the past two years the revenue of the company had been steadily increasing, while at the same time the expenses had been reduced. He thought that result was a matter for congratulation, and showed the efficient manner in which the business of the company was conducted. The average rate of exchange for the year was 16·65d., as compared with 15·17d. in the previous year. The net profit for the year amounted to £23,290, showing an increase for the year of £5,160. It would be noticed in the revenue account that the item of income-tax showed a rather big increase, which was caused by the higher rate which had been charged. Taking everything into account, the net result was £18,879, but of that £5,199 had been placed to the reserve account, and the proposed dividend amounted to £11,000, being at the rate of 5 per cent. on the ordinary shares free from income-tax. Last year the dividend was 4 per cent. The balance remaining, £2,680, which included £1,003 brought forward from last year, would be carried to the next account. This increase showed an all round improvement, and he hoped it would be considered very satisfactory. During the past year considerable extensions and improvements had been made to the company's lines. The Central Exchange at Chili had sent them a large number of subscribers, and in order to maintain the increase in the service there, they had ordered a new up-to-date switchboard, and expected to have it in working during the current year. In conclusion, he said he thought they might feel very satisfied with their position, and during the current year the business so far as it had gone continued to progress favourably.

Mr. Frank Jones seconded the motion and the report was adopted.

A dividend of 5 per cent. per share was afterwards declared.

Liverpool Overhead Railway Company.

The directors' report to come before the meeting to be held on Tuesday, August 13th, reads as follows:

In presenting the half-yearly statement of capital and revenue accounts to June 30th, 1901, the directors have to report that the gross revenue receipts amount to £41,701 4s. 8d., and the working expenses to £30,658 2s. 4d.

The number of passengers carried during the last two years is as follows:—

	Half-year ending Dec. 31st, 1899.	Half-year ending June 30th, 1900.	Half-year ending Dec. 31st, 1900.	Half-year ending June 30th, 1901.
First class	676,768	635,449	716,095	721,999
Second class, * including tramways	2,941,392	2,477,025	*3,369,883	*3,157,111
Workmen (special return tickets)	1,596,797	1,575,388	1,569,571	1,503,114
Total ..	5,214,957	4,687,862	5,655,499	5,382,224

The traffic on the railway has felt the extensions of the Liverpool Corporation tramways,— on the other hand, the traffic at Dingle station shows some signs of improvement. The Waterloo and Crosby tramways continue to yield satisfactory returns.

Your directors much regret the retirement, in consequence of ill-health, of Mr. Jas. Barrow, who has been associated with the undertaking from its earliest days, and who has given very valuable assistance. In his place they have elected Mr. Harvey C. Woodward.

Revenue Account.

	£	s.	d.
Receipts from passenger traffic amount to	40,673	16	0
Miscellaneous receipts and interest	1,027	8	8
	41,701	4	8
Less working expenses	30,658	2	4
	11,043	2	4
Deduct interest on mortgage debentures	3,400	0	0
	7,643	2	4
Add balance brought forward, December 31st, 1900 ..	4,079	13	4
Leaving available for dividend	11,722	15	8

Out of this balance your directors recommend the declaration of dividends at the following rates (less income tax), payable on and after August 16th, next:—

5 per cent. per annum on preference shares ..	£3,000	0	0
2 „ „ ordinary shares ..	5,000	0	0

leaving a balance of £3,722 15s. 8d. to be carried forward to next half-year.

The National Telephone Company.

The directors' report for the half-year ending June 30th, 1901, to be presented to the shareholders at the meeting to be held at Cannon Street Hotel on Thursday, August 15th, 1901, at 12 o'clock noon, reads as follows:—"The income accrued in respect of the business of the half-year amounts to £775,482 8s. 3d. as compared with £700,603 2s. 6d. for the corresponding period of 1900, being an increase of £74,879 5s. 9d. The working expenses for the half-year, including the special expenditure of £17,673 5s. 6d. incurred in repairing the damage caused by the snowstorms in the early part of the year, amount to £457,363 14s. 2d. as compared with £403,528 2s. 6d. for the corresponding period of 1900, being an increase of £53,835 11s. 8d. The net result for the half-year (after deducting the Post Office royalties amounting to £73,229 17s. 2d.) is a profit balance of £244,888 16s. 11d. as compared with £228,609 14s. 6d. for the corresponding period of 1900, an increase of £16,279 2s. 5d. The rentals carried forward for unexpired terms of running contracts amount to £784,755 14s. 11d. as compared with £733,614 16s. 5d. at the corresponding period of 1900, or an increase of £51,140 18s. 6d. Out of the available balance of £184,954 17s. 11d. shown by the net revenue account (No. 3) the board will recommend the payment for the half-year of a dividend at the rate of 6 per cent. per annum on the first and second preference shares, 5 per cent. per annum on the third preference shares, and 5 per cent. per annum on the ordinary shares, less income-tax in all cases. The board also propose to transfer £65,000 to the reserve fund, and to carry forward the balance of £5,954 17s. 11d. The sum of £303,696 18s. 3d. has been expended on capital account during the half-year in the erection of 7,393 additional exchange and private lines, and in the construction of underground works. The Right Hon. Lord Harris, G.C.S.I., G.C.I.E., having desired to be relieved of the more constant calls on his time involved by the

position of vice-president, the vacancy has been filled by the election of the Right Hon. Sir Henry Fowler, G.C.S.I., M.P. At the general meeting four directors retire, and being eligible offer themselves for re-election, viz., Mr. James Staats Forbes, the Right Hon. Sir James Fergusson, Bart, G.C.S.I., M.P, Mr. Eli Heyworth, and Mr. Samuel Herrick Sands. The auditors, Messrs. Welton, Jones and Co., also retire, and are eligible for re-election."

Dublin and Lucan Electric Railway Company.

The directors report that the accounts for the half-year ended June 30th, 1901, show that after including £49 12s. 8d. brought forward from last half-year, and providing for debenture interest to June 30th, there remains a balance of £497 13s., which is rather more than sufficient to pay a dividend at the rate of 5 per cent. on the preference shares. Having regard to the present being an unfavourable time for raising the small amount of new capital, which has been authorised to pay off the balance of expenditure due for electrical equipment– about £1,000—the board recommend that £400 out of the half-year's profits be used towards reducing the above amount, leaving a balance of £97 13s. to be carried forward to next half-year.

Stock Exchange Notices.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—County of London and Brush Provincial Electric Lighting Company, Limited—Further issue of £100,000 4½ per cent. debenture stock. Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to—Chelsea Electricity Supply Company, Limited—Further issue of 10,436 ordinary shares of £5 each. Electric Lighting and Traction Company of Australia, Limited—£75,000 5 per cent. debenture stock; and a further issue of 10,000 6 per cent. cumulative preference shares of £5 each.

British Insulated Wire Company.—Interim dividend on the ordinary shares for the half-year ended June 30th, at the rate of 10 per cent. per annum.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending August 2nd were £466; corresponding week last year, £489; decrease, £23. Total to date, £14,793, corresponding period last year, £13,523; increase, £1,269. Miles of track open, 8¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending August 5th were £1,310; corresponding week last year, £1,291: increase, £19. Total to date £5,541; corresponding period last year, £5,883; decrease, £342.

Bristol Tramways and Carriage Company.—The receipts for the week ending August 2nd were £3,798; corresponding period last year, £3,451; increase, £347.

Central London Railway.—The receipts for the week ending August 3rd were £5,079; corresponding week last year (six days), £4,923; increase, £1,836. Total receipts from July 1st (5 weeks), £30,077. Miles open, 6.

City and South London Railway.—The receipts for the week ending August 4th were £1,718; corresponding week last year, £1,541; increase, £177. Total to date, £9,268; corresponding period last year, £7,445; increase, £1,823. Miles open, 4½.

Dover Corporation Tramways.—The receipts for the week ending August 3rd were £300 11s. 3½d.; corresponding week last year, £275 16s. 4d.; increase, £24 14s. 11½d. Total to date, £6,232 16s. 5½d.; corresponding period last year, £5,839 15s 0d.; increase, £393 1s. 5½d. Miles of track open, 3. Car miles run, 1901, 5,802; 1900, 5,043. Number of cars, 11.

Dublin United Tramways Company.—The receipts for the week ending August 2nd were as follows:—D.U.T. Co., electric cars, £4,117 2s. 7d.; D.S.D. Co., electric cars, £1,246 15s. 1d.; total, £5,363 17s. 8d.; corresponding period last year—D.U.T. Co., electric cars, £3,923 6s. 9d.; ditto, horse cars, £31 4s. 2d.; D.S.D. Co., electric cars, £1,045 14s. 1d.; total, £5,000 5s. 2d.; increase, £363 12s. 6d.; aggregate to date, £24,842 0s. 2d.; aggregate to date last year, £24,006 10s. 7d.; increase, £835 9s. 8d. The mileage worked is 45 miles electrically, as against 42 miles electrically, and two miles by horses, for the corresponding period last year.

Glasgow Corporation Tramways.—For week ending August 3rd, £12,344 4s. 11d., compared with £9,070 9s. 5d. for same period last year.

Liverpool Overhead Railway.—The receipts for the week ending August 4th were £1,749; corresponding week last year, £1,635; increase, £114. Total from July 1st to date, £8,655; corresponding period last year, £8,499; increase £166. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

The money market is easy, and for the time being the Stock Exchange political horizon is tolerably unclouded. Of course the sad event which plunged two nations into mourning has not exerted any influence over stock markets. The House has again taken to its black ties, and upon resumption of work last Tuesday, an air of quiet gloom hung over everything, which was only accentuated by the absolute dearth of business. Consols are lifeless, and so long as they do not move one way or the other, investment stocks hang in their listless wake.

Central Londons are a good market in the midst of decidedly droopy ones in the home railway department. The directors' report is considered excellent, and the only point that calls for caution is contained in the auditors' certificate, which suggests the desirability of a fund being established for depreciation of rolling stock, machinery, and permanent way. No doubt the directors will take the hint to heart. In our last week's note we ventured to foresee a steady advance in the Preferred stock. A rise of 3 points during the interval adds justification to our remarks.

For a long lock-up investment it might perhaps be useful for the capitalist to look at Great Northern and City Preferred "A," now standing at 8 for the fully-paid £10 shares. The market is very limited indeed for the time being, and we fancy that there are an unpleasant number of underwriters about who would not mind selling at a discount. But the company's meeting the other day showed that the shareholders' affairs are in capital hands, and at the ruling quotation the "A" shares will pay 5 per cent. on the money when the line starts working—always provided that the full 4 per cent. be earned, of course. But the frightful congestion that now prevails on the Great Northern local lines augurs fair prospects of prosperity for its new brother-rival.

Echoes of the results from Twopenny Tube competition are plainly audible in the reports just issued by the North London, District and Metropolitan Railways, to say nothing of the London Road Car and London General Omnibus wails. The latter concern rather amusingly ignores the Central London entirely, and attributes its reduced profits to higher cost of forage, bad weather, and gaping streets. The London United Tramways Debenture stock is quoted 105 to 107, and, judging from the scenes of fighting that took place around the cars on Monday and Tuesday, the trams are more popular than ever. Of other traction varieties British Electric are dull at last week's prices. Potteries Ordinary, Preference, and 4½ Debenture are 12½, 10½, and 106 respectively, while £12 is the middle price of Calcutta and Dublin United alike.

In the electricity supply market the interim dividends now being announced are productive of little or no effect upon prices. "They mean so little," objected a man in the market to us the other day, "and are no real criterion of a company's condition." Perhaps he was thinking of the Edison and Swan, with whose report we dealt at length last week. We should not be at all surprised if some of the vague dissatisfaction crystallises into something more definite, and if the matter comes to an issue, perhaps the second Debenture stock may form the ground on which the fight will be waged. But, so far, things are as much in the air as a French flying machine, and the quotation for the Ordinary shares has shrunk to nothing-to-a-quarter.

Edmundson's have advanced to 6, and the Debenture stock is 1 per cent. harder. Brompton and Kensington Preference shed 5s., but the fall had nothing to do with the declaration of a 7 per cent. interim dividend on the Ordinary shares. Westminsters, by the narrowing of their quotation, are nominally ¼ lower, and with these there ends the tale of alterations in this section. Business is passing in Charing Cross 4 per cent. Debenture at 104, and City of London 4½ per cent. second Debenture is marketable in the neighbourhood of par.

Telegraph and telephone specialities are quiet as ever. Anglo "A" is a little harder, the meeting having a beneficial effect. The price has got back to 10, but other Anglo varieties are unaltered. The Pacific Cable scheme, although it has now reached the Parliamentary Bill stage, affects stocks in other companies not at all this week. Eastern Ordinary is a point up, and the price, it should be remembered, is now *ex* both dividend and bonus. The Eastern and South African Debentures are two down, equivalent to the interest deducted a week ago, and West India Ordinary have shrivelled to 7s. 6d. West African Telegraph Debentures quietly rise, and we see no reason to alter the good opinion that we expressed anent these bonds when they were 6 per cent. cheaper. Great Northern of Copenhagen are better, and there is a rise of 5s. to be recorded in Globe Telegraph and Trust shares. National Telephones are stationary, although the report shows the unwelcome fact that operating expenses are now 59 per cent., or 2 per cent. higher than they were in the previous half-year.

The miscellaneous market is marking time in the absence of business. Brush are dull, so are Electric Construction, and there is little support forthcoming for any but the highest-priced shares. British Westinghouse Preference are not better than 4⅜, notwithstanding the civic demonstrations at Manchester. There are 100,000 of these 6 per cent. Preferences dealt in by the London Stock Exchange. British Insulated Wire are hard, upon the declaration of a 10 per cent. interim dividend. As regards new issues, the methods of the Blackpool Electric Tramways (South) for obtaining subscription to the shares are anything but commendable. The sending out of newspaper cuttings showing that the shares are dealt in at a "premium," (the company does not state on what Exchange) is too plainly in the nature of a bait, and all things considered, it might be just as well if those who had subscribed were to reconsider their applications and apply for the return of their money forthwith.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for he last three years. 1898.	1899.	1900.	Closing Quotations July 31st.	Closing Quotation Aug. 7th.	Business done during week ended Aug. 7th. 1901. Highest.	Lowest
96,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	98 —101 xd	98 —101 xd	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	78 — 83	78 — 83	...	...
822,700£	Anglo-American Telegraph	Stock	£3 9s.	73/6	3½ %	52 — 55 xd	52 — 55 xd	...	...
3,088,540£	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	97 — 99 xd	97 — 99 xd	98¼	97¼
3,088,540£	Do. do. Deferred	Stock	18s. %	£1 7s.	5s. %	9½ — 10	9¾ — 10½	9⅝	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	5 %	3¾ — 4½	3¾ — 4½	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	175 —185 xd	175 —185	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	101 —103	101 —103	102½	101¾
16,000	Cuba Telegraph	10	8 %	7 %	...	7 — 8	6½ — 7½	...	...
6,000	Do. 10 % Pref.	10	10 %	...	...	14½ — 15½	14½ — 15½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9 — 10	9 — 10	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	99 — 103⅜xd	99 —103⅜ xd	...	...
60,710£	Direct United States Cable	20	3½⅜	3½⅜	3½⅜	10½ — 11½	10½ — 11½	...	...
104,300£	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102 xd	99 —102 xd	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	140 —145	141 —146	144¼	142
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	92 — 95	92 — 95	94½	93
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	110 —114	110 —114	...	...
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	13¾ — 14¼	13¾ — 14¼	14 3/16	14
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	110 —115	110 —115	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	5¼ %	...	101 —104	99 —102	100½	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103%	100 —103%	...	...
180,227	Globe Telegraph and Trust	10	5⅛%	5¼%	5¼%	10 — 10½xd	10½ — 10⅝xd	10⅛	10¼
180,042	Do. do. 6 % Pref.	10	6 %	...	...	14¾ — 15¼xd	14¾ — 15¼xd	15⅛	...
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	15 %	30 — 32	31 — 33	...	...
78,000£	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102 xd	99 —102 xd	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	41 — 45	41 — 45	44	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	...	...	...	103 —106	103 —106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	2½%	...	½ — ⅝	½ — ⅝	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	⅝ — 1	⅝ — 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	3¼ — 3½	3¼ — 3½	3⅜	3 5/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	12⅜	12 3/16
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅛ — 4⅜	4⅛ — 4⅜	...	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	89 — 92	89 — 92	...	...
500,000£	Do. 4 % Deb. Stock Red.	100	...	...	4 %	94 — 97	94 — 97	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	⅞ — 1	⅞ — 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102 xd	99 —102 xd	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	...	...
58,000	United River Plate Telephone	5	6 %	7 %	...	5 — 5½xd	5 — 5½xd	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4⅜ — 5½xd	4⅜ — 5½ xd	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	101 —104	101 —104 xd	103½	103
171,000	West African Telegraph, 5 % Debs....	100	...	...	...	100 —103	101 —104	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½ — ⅝	½ — ⅝	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	13⅜ — 14½	13⅜ —14½ xd	14⅝	...
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	101 —104 xd	101 —104 xd	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	100 —103 xd	100 —103 xd	...	...
88,321	West India and Panama Telegraph	10	2 %	⅝%	...	⅝ — ⅝	⅝ — ⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	4½ — 5½	5 — 6	5 3/16	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3 — 5	3 — 5	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	101 —104 xd	101 —104 xd	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7⅞ — 8¼	7⅞ — 8¼	8⅜	...
12,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8¾ — 9	8¼ — 8¾	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10	...	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5½ — 5⅝	5½ — 5⅝	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	5½ — 6	5½ — 6	5⅞	...
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	107 —110 xd	107 —110	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	6 %	4 %	0 %	8 — 9	8 — 9	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12 — 13 xd	12 — 13 xd	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	120 —125 xd	120 —125 xd	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	4 %	4 %	8½ — 9½	½ — 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	12 — 13	12 — 13	...	...
200,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	103 —106 xd	103 —106 xd	...	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	6 %	7 %	5⅝ — 6 xd	5⅜ — 6¼	6	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5¼ — 6 xd	5½ — 6	5 13/16	5⅝
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	102 —105 xd	103 —106	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12 xd	11 — 12	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104 xd	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½ — 1⅝	1½ — 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	4 — 5	4 — 5	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	96 —100	96 —100	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	13 — 14	13 — 14	...	...
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	108 —111 xd	108 —111 xd	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	94 — 97 xd	94 — 97 xd	...	...
6,452	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15 — 16 xd	15 — 16	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½ — 15½xd	14½ — 15½xd	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½ — 9½xd	8½ — 9½	...	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	97 —100 xd	97 —100 xd	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90 xd	80 — 90 xd	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½ — 3½	2½ — 3½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	13 %	10½%	11½ — 12½	11½ — 12	11 13/16	11 7/16

* Subject to Founders Shares. Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

desirability of a fund being established for depreciation of rolling

money forthwith.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation July 31st.	Closing Quotation Aug. 7th.	Business done week ended Aug. 7th, 1901. Highest	Lowest.
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	7 — 8	7 — 8	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	89 — 93	89 — 93	...	...
45,000	British Electric Traction	10	6 %	8 %	9 %	13¾ — 14½	13⅞ — 14½	14½	12⅜
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 12½	12 — 12½	12 7/16	...
350,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	122 —125	122 —125	124½	...
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	10 — 11 xd	10 — 11 xd	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½xd	...	...
90,000	Brush Elecl. Engng., Ord., 1 to 90,000	2	5 %	6 %	...	1⅝ — 1⅞	1½ — 1⅝	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2⅛ — 2⅜	2 — 2¼	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	103 —108	103 —108	...	...
108,710*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	99 —102 xd	99 —102	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	15 %	14 — 15	14 —15	14⅜	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	5 5/16	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	107 —111	107 —111 xd	...	...
206,297	Central London Railway, Ord. Stock	Stock	...	...	...	98 —101	99 —102	100¼	99
78,703	Do. do. Pref. half-shares	5	...	...	...	99 —102	102 —105	...	...
78,703	Do. do. Def. do.	5	...	...	...	97 —100	98 —101	...	...
855,000	City and South London Railway	Stock	2⅛%	1⅞%	1¼%	52 — 54 xd	52 — 54 xd	...	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	5¼ — 5⅜	5¼ — 5⅜	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½ %	8 %	3½ — 4	3½ — 4	3½	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	100 —105 xd	100 —105	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	2½%	0 — ¼	0 — ¼	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	2½%	1½ — 2½	1½ — 2½	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	80 — 85 xd	80 — 85	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	88 — 92	85 — 90	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1⅜ — 2¼xd	1½ — 2	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	...	...	2½ — 3 xd	2¼ — 2⅜	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	98 —102 xd	98 —102 xd	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	9⅜ — 10½	9⅜ — 10½	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	99 —102	99 — 102	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	15½ — 16½	15½ — 16½	16½	16
35,000	Do. do. do. 4½ % Pref.	5	...	4½%	4½%	5½ — 6	5½ — 6	5⅝	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	109 —113	109 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	21⅜	...
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	101 —104	101 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3⅜%	3½%	7 1/16 — 7 1/16	7⅛ — 7¼	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5	...	13 — 13¼	13¼ — 13½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	...	6 %	... — ...	19/- to 20/-	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½ %	37 — 41	37 — 41 xd	39¾	...
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	... %	...	101 —104 xd	101 —104 xd	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	8 %	12 %	12 %	10½ — 11½	10½ — 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	90 — 93	90 — 93	91¾	91¼

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 1/8—3/8
National Electric Free Wiring, 12/6 paid, 11/8—1/8.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16½.
Do. do. Pref. (£10 pd.), 10—11.
*T. Parker, £10 (fully paid), 16½.

* From Birmingham Share List.

Bank rate of discount 3½ per cent. (June 6th, 1901).

MARKET QUOTATIONS, Wednesday, August 7th.

CHEMICALS, &c.	This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a ,, Nitric .. .. .. per cwt.	22/-	22/-	..
a ,, Oxalic .. .. .. per cwt.	32/-	32/-	..
a ,, Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) .. per ton	£33 10	£33 10	..
a ,, ,, .. per ton	£30	£30	..
a Bleaching powder .. .. per ton	£7	£7	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£15	£15	..
a Bensole (90 %) .. .. .. per gal.	7/-	7/-	..
a ,, (50/90%).. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. per ton	£23	£23	..
a Lead, Nitrate .. .. .. per ton	£24	£24	..
a ,, White Sugar .. .. per ton	£31	£31	..
a ,, Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C). per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3¼d.	3¼d.	..
a ,, Caustic (75/80%) .. per ton	£24	£24	..
a ,, Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. .. per cwt.	61/-	61/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a ,, Recovered .. .. per ton	£5 10	£5 10	..
a ,, Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£10 15	£10 15	..
a ,, Crystals .. .. .. per ton	£3	£3	..
Bichromate, casks .. per lb.	2¾d.	2¾d.	..

METALS, &c.	This week.	Last week.	Inc. or Dec.
b Aluminium Wire, in ton lots.. per ton	£224	£224	..
b ,, Sheet, in ton lots per ton	£191	£191	..
p Babbitt's metal ingots.. .. per ton	£75 to £140	£75 to £140	..
c Brass (rolled metal 2" to 12") basis per lb.	7⅞d.	7⅞d.	..
c Tube (brazed) .. .. per lb.	10d.	10d.	..
c ,, ,, (solid drawn) .. per lb.	8¼d.	8¼d.	..
c ,, Wire, basis .. .. per lb.	8d.	8d.	..
c Copper Tubes (brazed) .. per lb.	11d.	11d.	..
,, ,, (solid drawn) .. per lb.	10¾d.	10¾d.	..
g Copper Bars (best selected) .. per ton	£85	£85	..

METALS, &c. *(continued.)*	This week.	Last week.	Inc. or Dec.
g Copper Sheet .. .. .. per ton	£85	£85	..
g ,, Rod .. .. .. per ton	£85	£85	..
e ,, (Electrolytic) Bars .. per ton	£82	£82	..
e ,, ,, Sheets .. per ton	£90	£90	..
e ,, ,, Rod .. per ton	£84	£84	..
e ,, ,, H.C. Wire per lb.	9¾d.	9¾d.	..
f Ebonite Rod .. .. per lb.	8/-	8/-	..
f ,, Sheet .. .. .. per lb.	5/-	5/-	..
n German Silver Wire .. .. per lb.	1/5	1/5	..
h Gutta-percha fine .. .. per lb.	8/-	8/-	..
h India-rubber, Para fine .. .. per lb.	3/6 to 3/7	3/6 to 3/7	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i ,, Pig (Cleveland warrants) .. per ton	46/4	45/4	1s. inc.
i ,, Forgings, according to size per ton	From £11	From £11	..
i ,, Scrap, heavy .. .. .. per ton	50/- to 52/6	50/- to 52/6	..
i ,, Wire, galvanised No. 8 .. per ton	£10	£10	..
g Lead, English Ingot .. .. per ton	£12 5	£12 2 6 to £12 5	..
g ,, ,, Sheet .. .. per ton	£13 10	£13 10	..
m Manganin Wire No. 28 .. .. per lb.	8/-	8/-	..
g Mercury .. .. per bot.	£9	£9	..
d Mica (in original cases), small .. per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, ,, medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large .. per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p ,, rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet per lb.	From 1/3	From 1/3	..
o Platinum .. .. per oz.	£4 1	£4 1	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/0½	10½d. to 1/0½	..
i Steel, Magnet, acc'd'ng to desc'p'n per ton	From £15 to £40		..
i ,, ,, in bars	£58	£58	..
g Tin, block .. .. per ton	£120 to £121	£120 to £121	..
g ,, foil .. .. per lb.	1/6	1/6	..
n ,, wire, Nos. 1 to 16 .. .. per lb.	1/9	1/9	..
p White Anti-friction Metals — "White Ant" brand .. .. per ton	£35 to £65	£35 to £65	..
j Yarns, Cotton, Single 10 lb. b'ndl's per lb.	8½d.	8½d.	..
j ,, Best Flax, 6 lea. .. .. per lb.	6d.	6d.	..
j ,, Hemp, 3 ply 10 lbs. .. per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs. .. per lb.	5½d.	5½d.	..
j ,, Jute, 180 lbs. rove .. per ton	£14	£14	..
k Zinc, Sh't. (Vielle Montagne bnd.) per ton	£22 10	£22 10	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd e Messrs. Thos. Bolton & Sons. d Messrs F. Wiggins & Sons. c Messrs Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Jackson & Till. i Messrs. Bolling & Lowe. j Messrs. Henry C. Yeo & Co.

Quotations supplied by { k Messrs. Morris Ashby, Limited m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd p The Phosphor Bronze Company Ltd

* Subject to Founders Shares. Quotations on Liverpool Stock Exchange.
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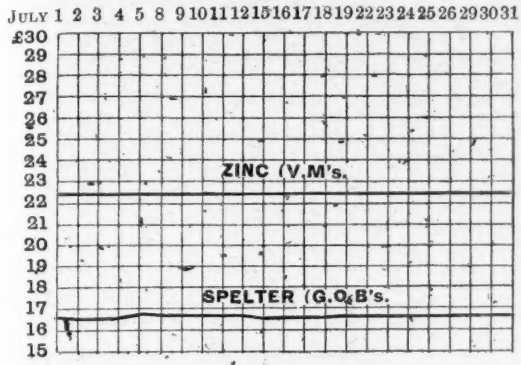
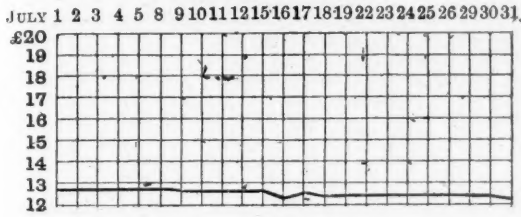
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

METAL MARKET.

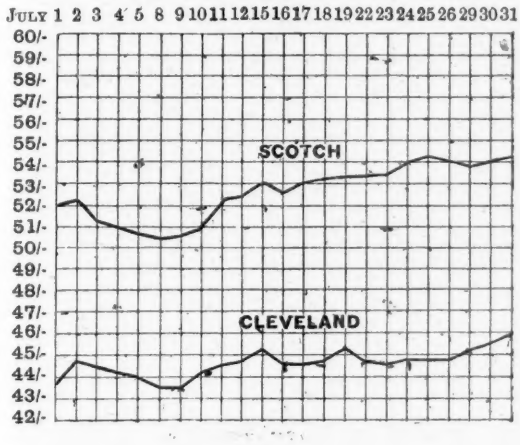
Fluctuations in July.



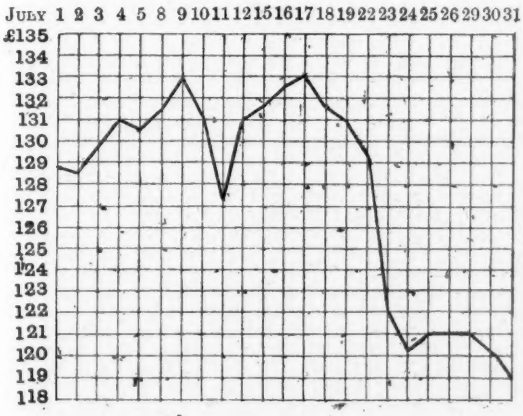
LEAD (ENGLISH).



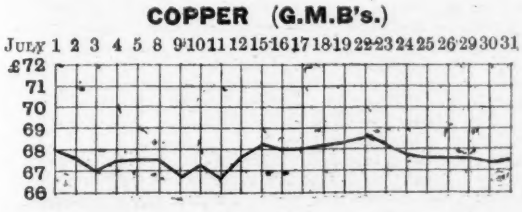
IRON.



TIN.



COPPER (G.M.B's.)



IMPORTANT EUROPEAN ELECTRICAL AND ENGINEERING DEVELOPMENTS.*

By WILLIAM J. HAMMER.

(*Concluded from page* 207.)

The three-phase liquid rheostat is a feature of considerable interest. It consists of an iron box having three wings to it. From the top of the box depend three separate cylinders. Supported inside each cylinder are two sets of iron plates. They are of varying length, and are rounded at the lower extremity. The alternate plates are connected in pairs, the current entering by one pair and leaving by the other, the sets being attached to the three phases of the low-tension rotor circuits, which have a potential of 300 volts. The lower portion of the outer case contains a solution of sodium carbonate. The upper portion of this outer case is supplied with compressed air, which, according to the rate at which it is allowed to pass into the outer chamber, causes the liquid to rise in the three cylinders. The liquid, as it rises, comes in contact with the various iron plates, one after the other, and more or less resistance is thus cut out of circuit, depending upon the height of the solution. By releasing the air pressure in the outer compartment, the solution immediately drops into the lower part of the case, and the plates are then entirely separated from each other. The entire height through which the solution passes is less than 12 in. This resistance box, which is the result of a large amount of experimentation, enables the motor torque to be kept constant during acceleration. The air exhaust valve is a lift type of valve, normally kept open by a spiral spring. The valve for operating the rheostat is compound, having several ways through it. On being operated, it first opens a clear way for the compressed air to a cylinder, and to the top of a piston which compresses the spiral spring above referred to, and closes the exhaust valve. The air is next admitted slowly through a small throttling aperature which admits the air at low pressure, to the outside of the resistance box casing. When half-speed has been attained, the motion of the controller lever when thrown to full speed, causes the air cock to close the throttling aperture, and open another, relieving the air above the upper surface of the exhaust valve piston, and permitting the compression spring on this valve to instantly open it thus throwing in again instantly the whole resistance. These operations are repeated in securing acceleration from half to full speed, and in securing retardation from full to half speed, at which time the motors are in "cascade," as described.

The motors are direct-connected to the axle; that is, there is no gearing; the rotor axle is hollow, with an internal diameter of 8 in., and is lined with brass, permitting the car axle, which has a diameter of 4 in., to pass through it. The circuits to the three collector rings pass through grooves in the rotor shaft. The rotor shaft and the car wheels are flexibly connected, and thus jarring and vibration are prevented. The rotor has at one end the three collector rings, upon which rest the three carbon block brushes. At the other end of the rotor is a driving flange, which is connected to the driving wheel on that side through two links, one of which acts by thrust and the other by tension, the two stresses being of equal magnitude.

In the experimental plant at Alte-Ofen, Buda-Pesth, a potential of 3,000 volts was supplied from a neighbouring plant, and the locomotive had but two motors upon it. I am indebted to Dr. Otto F. Blathy and Mr. Windisch Antal, of Messrs. Ganz & Co., and to Mr. Francis Jehl, for assistance in preparing these data and for my trips over the road.

Siemens & Halske High Tension Three-Phase Railroad.

The firms of Siemens & Halske, Allgemeine Elektricitäts Gesellschaft, and Borsig & Co., of Berlin, have formed an organisation for the study of problems connected with the operation of electric railways under steam conditions. The work I shall refer to here has been prosecuted by the first mentioned firm, which has for a considerable period given this subject attention. I am indebted to the company's engineers, particularly to Mr. Walter Reichel, the chief engineer of Messrs. Siemens & Halske, for the data here presented. Mr. Michael Dolivo-Dobrowolsky, chief engineer of the Allgemeine Company, informed the author that his company is also constructing a locomotive for experimental test, and Borsig & Co., the well-known engine builders, are co-operating with the other concerns in this important undertaking. Messrs. Siemens & Halske had made some interesting experiments with three-phase current in the year 1892 at the Werner Works, Charlottenburg, upon a track 360 metres long, and in the year 1897 decided to build a special experimental line for testing an electrical equipment employing rotary current motors, and an E.M.F. of 10,000 volts, and for testing various types of trolleys, circuit safe-guards, crossing constructions, &c. The line was built from Grosse Lichterfelde to Zehlendorf over the Teltow road, and was undertaken in the spring of 1898, the track being laid for 1·8 kilometre, standard gauge, with the power station at about the centre of the line. The more recent tests referred to here, were conducted in the spring and fall of 1899, and the final tests in the spring of 1900.

The trolley line was arranged with a protective net below the conductors. In the first arrangement the current was taken off by sliding contacts on the top of the wires, but subsequently this was altered to

* Abstract of paper read by Mr. W. J. Hammer before the American Institute of Electrical Engineers, February 28th, 1901.

Quotations supplied by { c Messrs. Thos. Bolton & Sons. d Messrs F. Wiggins & Sons. e Messrs Frederick Smith & Co.
Quotations supplied by { h Messrs. Jackson & Till. i Messrs. Boiling & Lowe. j Messrs. Henry G. Yeo & Co.
supplied by { n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd p The Phosphor Bronze Company Ltd

side rubbing or sliding contacts. It was feared that at the high rates of speed desired, the ordinary forms of trolley wheels, loops and rollers, would tend to leave the w re. All three of the trolley wires, which are of hard-drawn copper wire 8 mm. diameter, were placed at the side of the road, in order to get rid of the effect produced upon the telephone system by using the track for one phase. The wires were held by porcelain bell insulators, tested for half an hour under water at 1,500 volts; these lay on an inclined plane, and were screwed to wooden arms pivoted to the iron poles, permitting the wires to be strung and maintained separately and evenly both winter and summer. Tension is kept on the wires by heavy weights placed inside the lattice poles at definite intervals, which act through a loose pulley and a block with six pulleys, and give a strain of 1,500 kg. on the wires. All the supports are lattice poles 40 metres apart, the poles carrying the weights being heavier and set in cement. As a precaution all the poles are separately connected to the rails by a copper wire 8 mm. diameter. The trolleys consisted of strong aluminium pieces, pivoted about a horizontal axis, and fastened to an iron pipe, the contact parts swinging in a perpendicular plane to the working wires, against which they are held by a spring. In the system later employed, all three conductors lie in a vertical plane one metre apart. Curved iron supports are attached to the lattice poles. At the ends of these supports are tension devices, and the insulator supports are fastened at a slight angle. The three-part porcelain bell insulators are fastened to the support by means of a hempen rope; there is double insulation top and bottom. Sections of the conductor can move sideways, and yield to pressure as in the case of the ordinary underrunning trolley. Metallic supports for the trolley wires tightly embrace the neck of the porcelain insulators by means of pressure screws and spring rings. Three bow trolleys are mounted on top of the locomotive, pivoted upon perpendicular axles, all of the same height, which are insulated by strong hard rubber insulators. The loops or bows are of different lengths and inclinations. They also pivot horizontally to pass below crossings, &c., and are controlled simultaneously by a worm gear, operated from inside the cab. The working conductors and trolleys were tested with a pressure as high as 30,000 volts. Power is supplied from the sub-station of the Grosse-Lichterfelde Railway, which has a storage battery and direct-current motors for driving a three-phase dynamo. The latter is 12-pole, giving normally 700 volts and 50 periods, and 120 to 250 amperes at 500 revolutions per minute. This machine can be completely altered so that potentials from 385 to 4,000 volts can be developed. There is also a rotary current transformer, with a transforming relation of $\frac{750}{10,000}$ volts with $\frac{157}{11{\cdot}5}$ amperes normal. With this plan it was possible to secure 750 volts directly, 2,000 volts directly, and 10,000 volts by transformation. The transformer, dynamo frame and instrument cases were all grounded as a precaution. As first operated, the transformer stepping down from 10,000 to 750 volts was drawn along on a separate attached car with trolleys, in order to better observe the sliding contacts, and to be free from the high tension at the motor, which has no iron casing. There was also only enough room in the locomotive for the large resistances and other apparatus. Later an iron top casing was put on the locomotive, in which the transformer was placed.

The metal parts of the locomotive are grounded to protect against the difference in potential. The weight of the locomotive complete is 16,000 kg. It is equipped with two rotary current motors, one on each of the two axles, operating at 650 to 850 volts and 30 H.P. normal. The current is taken direct to the stationary windings. The rotor is provided with slip rings and ventilation. The air gap is 1·5 mm. Tested, these motors show an efficiency of 88·5 per cent., and the highest type is of 120 H.P. with 650 volts, which is increased to 200 H.P. at 850 volts. The motors are flexibly suspended, similar to the street railway motors, and can turn upon the axles. Two pair of gear wheels serve to change the speed, with a gear of 1 : 4·65 for a speed of 40 km. and 1 : 3·15 for a speed of 60 km. For the operations of 750, 2,000 and 10,000 volts, the same motors, frames, and rotary parts were used—only the stationary parts being exchanged for the direct operation with 2,000 volts. A controller constructed for 750 volts is employed for the switching in and out, and for the starting of the motors; this has in its interior a reverser drum for changing the running direction, and a controller drum for switching the stationary windings of the motor in and out. The controller drum is mechanically connected by a chain gear with the starting devices for the rotating parts of the motors. When running with 750 volts, the controller is directly connected with the trolleys. When running with 10,000 volts, it is connected through the transformer, from 10,000 volts to 750 volts, and a switch for 10,000 volts. Running with 2,000 volts the supply conductors to the primary parts of the motor can be cut off from the controller, and the car operated by two auxiliary switches, and without the use of the transformer. The reverser drum of the controller is so arranged that when employing an additional transformer (for instance, with 10,000 volts) different currents can be taken off, thus obtaining the higher torque when starting through a higher E.M.F. (850 volts) than during the normal running (650 volts). The reverser drum finally has steps at which only two phases are connected up, it being thus possible to reduce the running speed by half. The starting devices are completely separated from one another, to facilitate the cutting out of each motor, and to avoid any irregularities in the synchronism of the motors, with wheels whose diameters do not correspond. The controller is placed in the centre of the locomotive. The high tension switch is outside at the end where one transformer is placed, and the starting devices are in the corresponding space which the other transformer occupies. The high tension switch is provided with a tube spark extinguisher, and the controller with a magnetic blow-out and a successive cut-out for the different phases. Connections between the controller, starting resistances and motors are carefully insulated to stand 4,000 volts, and are mechanically protected by rubber tubes, 6 mm. thick. Connections between trolleys and transformers are protected by iron pipe. Ordinary packed resistances are employed, suspended beneath the car floor, near the starting devices, and properly protected. Safety fuses are on each side of the three low tension circuits, the high tension circuits being protected at the power house. Siemens horned (non-inductive) lightning arresters are used on the locomotive for each phase.

A locomotive with a load of 30 tons was run up to a speed of 60 km. in 60 seconds time, with 700 volts and 190 amperes. The locomotive, alone, attained the same speed in 30 seconds. When run with a load of 30 tons at 60 km. per hour, the motor consumed 70 amperes at 700 volts. As is known, the starting torque varies with the square of the voltage; therefore, by increasing from 670 to 950 volts, the starting torque can be increased to double that at the normal tension. This can easily be obtained when employing transformers (in the operation with 10,000 v) by the addition of coil sections. The speed may be regulated by resistances in the secondary, by opening a secondary circuit, or by "cascade" coupling. The first method causes a loss of energy; in the second the motor has a somewhat less maximum torque—less efficiency, and a smaller output corresponding to half the number of revolutions; it is, however, preferable to resistance regulation. The same may be said of the "cascade" coupling, in which the torque is reduced to half of the output = to $\frac{1}{4}$. A braking action of the motors was obtained by decreasing the number of alternations of the dynamo through an increase of the field of the driving motors; likewise current was sent back to the accumulator battery, when going down hill.

The "Jungfrau" Three-Phase Railway.

The Jungfrau Railroad, which has been under construction since 1897, and which, it is estimated, cannot be completed before 1908 to 1910, has attracted the attention of engineers the world over. It employs three-phase current of 7,000 volts, supplied by generators, operated by water power. The current for operating the locomotive is transformed to 500 volts. Two overhead contact wires are employed, the rails being used as the third conductor. Double trolleys with both slide and wheel contact makers are employed.

The present station at Lauterbrunnen will supply 2,000 H.P. from the "Weisse" Lutschine, and that at Grindelwald will supply, when completed, 3,000 H.P. This supply comes from the "Schwartze" Lutschine which gives 9,000 available horse-power. The total length of the transmission line from the Lauterbrunnen Station to the top of the mountain is about 20 miles. There will be about 7 miles of tunnel on this road—alone costing $1,000,000. Owing to the nature of the rocks it has not been necessary to face the tunnel with stonework.

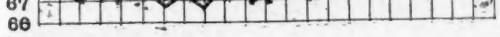
There are five locomotives, each being equipped with two 220-H.P. induction motors. The locomotives are designed to make an ascending speed of 5 miles an hour and draw two cars seating 80 persons. A controller cuts resistance in and out of the rotor circuits. In the first locomotives one resistance was used for two motors. This had the disadvantage of producing "hunting" when the two motors were thrown in parallel, and caused a jarring action at times. In the later types each motor had a separate resistance, which was used not only for starting, but also for absorbing current when the locomotive was descending, at which time the motors were left in circuit to secure the automatic braking action, giving the generators a nearly constant load. These descending locomotives may at times supply current to the line, thus assisting the ascending cars. The locomotives will start themselves on a grade of 25 per cent. By mounting one end of a car on an extension of the locomotive frame the traction has been favourably increased, and to secure the greatest benefit of this weight the cars are put in front of the locomotive in going up hill, and behind it in descending.

It was customary at one time, before descending, to signal the Lauterbrunnen power house, and resistance was put in circuit, but later the locomotives were equipped with a resistance qualified to absorb the whole current generated by the motors in descending. This saves wear and tear on brakes and turbines, generators, &c., and wastes no extra power, as the water must pass the power house at any rate.

The cars are equipped with hand, automatic and electric brakes, as required by Swiss mountain regulations. Messrs. West-Kunz and Thorman, in their report to the Jungfrau Railway Commission upon the relative advantages of employing three-phase transmission with rotary converter sub-stations and continuous current motors on the locomotives, as compared with the employment of three-phase current throughout, advised the employment of the latter for the following reasons:—

(1) Because of the greater simplicity of the regulating arrangements of the motors; (2) because of the automatic braking action in descending grades; (3) because of the expense and difficulty in maintaining sub-stations, employing rotating machinery, and assistants to relieve each other periodically; (4) because, after very careful estimates had been prepared from manufacturers' actual prices, it was found that the first cost of the rotary converter method would be over 50 per cent. greater than that of a system in which three-phase currents only were employed.

When the road is completed it is proposed to transport the passengers 300 ft. higher, to the summit, by means of an electric elevator, upon which will be mounted a three-phase motor, carrying two pinions, working in racks on the side of the shaft. The



American Institute of Electrical Engineers, February 28th, 1901.

Jungfrau is 13,667 ft. above the sea level and 11,808 ft. above Interlaken.

The electric road is now open from Kleine Scheidegg—which is 4,270 ft. above Interlaken—to Rothstock, and although financial difficulties have recently delayed the work, it is expected that Eismere will be reached in 1903, and, as before stated, the road entirely completed between 1908 and 1910.

When completed, the round-trip fare will be 35 francs or about $7.

The entire cost of the road when completed is estimated at $2,000,000.

A difficult problem has been to satisfactorily reduce the speed of locomotives going down hill, which always exceeds the ascending speed by reason of the fact that three-phase generators run faster as generators than as motors. The Oerlikon Company has neatly solved the difficulty by attaching a small direct current dynamo to the motor-shaft and supplying a direct current to the stator windings of each motor; a resistance placed in circuit permits the regulating of the direct current and secures a speed about half that of ascending. When the locomotive starts to descend, the overhead trolleys are lowered, and the three-phase current generated by the rotor is absorbed by the motor-starting resistance, which is much less than formerly. This brake arrangement has displaced the magnetic brake, which is only in circuit when going uphill.

It is said that before 1851 but five successful attempts were made to ascend the Jungfrau, and while many plans have been suggested for carrying the public to the summit, it remained for the celebrated engineer, Mr. Guyer Zeller, to bring forward the first practicable plan. This was in 1893, and in the following year he was granted the necessary franchise to carry out the work, which he prosecuted with great energy and skill until his death in the year 1899.

FIVE HUNDRED MILES' TRIAL OF RELIABILITY OF MOTOR VEHICLES.

The five 100-miles (or approximately 100 miles) trials are to take place on five successive days, viz, from September 2nd to September 6th next, at Glasgow, and are the outcome of the extremely energetic policy of the Automobile Club of Great Britain and Ireland in advancing the automobile movement in this country and Ireland. These trials have been preceded by many similar trials and test runs inaugurated by this club, notably, runs to Brighton, Southsea and other places, hill climbing test on Dashwood Hill and elsewhere, exhibitions at Richmond, Dover, Agricultural Hall, London, trials of carriages for 100 miles without a single stop, a run of 1,000 miles from London to Edinburgh and back, through Birmingham, Carlisle, Newcastle and Leeds; and lately the demonstrations before members of County Councils in different parts of the country to prove the ease of control and safety of motor vehicles at the very reasonable and safe limit of speed allowed, as well as many enjoyable club runs, all bear witness of the earnestness of the club committees and officials in advocating and advancing the new industry, so as to enable this country to compete with other countries, and not be behind in the movement which is now revolutionising traction and travelling on common roads. The best thanks of all those interested are due to the club for their very successful efforts.

The Scottish Automobile Club is working in conjunction with the Automobile Club of Great Britain and Ireland (the parent club), and the trials are also under the patronage of the council and committee of the Glasgow International Exhibition, and are to be under the supervision of the Sports Committee of that Exhibition, who will award medals for the most successful vehicles. It is one of the conditions that the competing vehicles shall be shown in the grounds of the Glasgow Exhibition at the end of each day's run, so that intending purchasers of motor vehicles and others interested may be guided by the awards of the judges, and have an opportunity of forming their own opinion.

The Automobile Club of Great Britain and Ireland now numbers nearly 1,000 members, many of whom own motor carriages. The council is a most influential one, including his Grace the Duke of Sutherland, the Right Hon. the Earl of Shrewsbury and Talbot, the Right Hon. the Earl of Onslow, G.C.M.G., the Right Hon. Earl Grey, Lord Robert Cecil, Lord Kelvin, Sir James Pender, Alfred de Rothschild, and many other well-known men, whilst other clubs and societies are affiliated with the parent club, and their presidents are members of the council, viz.:—The Right Hon. the Earl of Derby, K.G., the president of the Liverpool Self-propelled Traffic Association; the Right Hon. Sir J. H. A. Macdonald, K.C.B, Lord Justice Clerk of Scotland, for the Scottish Automobile Club; W. G. D. Goff, Esq., J.P., the chairman of the Irish Automobile Club, as well as the Presidents of Manchester, Yorkshire, Lincolnshire, Midlands and Nottingham Automobile Clubs.

The chairman of the Automobile Club is Roger W. Wallace, Esq., K.C. The Hon. John Scott Montagu, M.P.; Sir David Salomons, Bart.; Henry Edmunds, Esq.; Paris Eugene Singer, Esq.; the Right Hon. Lord Suffield, K.C.B.; and John L. Thornycroft, Esq., F.R.S., are some of the members, whilst the judges' committee are:—

The Right Hon. Sir J. H. A. Macdonald, K.C.B., LL.D., F.R.SS. (L. & E.), M.Inst.Elec.E., Lord Justice Clerk of Scotland, Chairman.
Prof. Archibald Barr, D.Sc., M.Inst.C.E.
Prof. Hudson Beare, B.Sc., M.Inst.C.E., M.Inst.Mech.E.
W. Worby Beaumont, Esq., M.Inst.C.E., M.Inst.Mech.E.
Prof. D. S. Capper, M.Inst.C.E., M.Inst.Mech.E.
Dugald Clerk, Esq., M.Inst.C.E.
Bryan Donkin, Esq., M.Inst.C.E., M.Inst.Mech E.
Prof. Hele-Shaw, LL.D., F.R.S., M.Inst.C.E., M.Inst.Mech.E.
Lieut.-Colonel H. C. L. Holden, R.A., F.R.S.
Sir William H. Preece, K.C.B., F.R.S., P.P.Inst.C.E.
Prof. William C. Unwin, F.R.S., M.Inst.C.E.
A. F. Yarrow, Esq., M.Inst.C.E, M.Inst.Mech.E.

With Mr. Claude Johnson, the secretary, a most ardent motor enthusiast, and the indefatigable organiser of the routes and programmes of the trials and tests under the committee's direction.

We have gone somewhat fully into the standing and purposes of this club, as we think that its energetic action in promoting the best interests of its members is an example that might with advantage be followed by some of the old-time electrical clubs and societies, and whilst most of the members of the Automobile Club favour petrol, or steam motor vehicles, there are a considerable number working with might and main in the interests of electro-mobiles, or electrically-propelled vehicles, and we desire to do all we can to assist them in the advancement of a new electrical industry.

The five trial runs are as follows:—

September 2nd.—Glasgow to Edinburgh *viâ* Bathgate, and back from Edinburgh to Glasgow *viâ* Biggar and Lanark, 116½ miles.

September 3rd.—Glasgow to Ayr *viâ* Port Glasgow, Largs, and Killwinning, and back *viâ* Kilmarnock, 107¾ miles.

September 4th.—Glasgow to Callander *viâ* Fintry, and back *viâ* Drymen, 96½ miles.

September 5th.—Glasgow to Stirling, through Dunblane and the hills to Yetts of Muckart, and by Tillicoultry again to Stirling, and back to Glasgow *viâ* Kirkintilloch, 95½ miles.

Setember 6th.—Glasgow to Crianlarich *viâ* Dumbarton, Helensburgh, Arrochar, and Tarbet, and back to Glasgow *viâ* Tarbet, Luss, Alexandria, and Bowling, 115¾ miles.

The programme issued by the club is full of the most explicit and detailed instructions as to routes, cautions, and the difficulties as to steep hills (and there are many steep hills), narrow roads, level railway crossings, crossing streams, &c., and enjoins great care in passing through certain towns and villages, to slow down where young children are about, as well as a repeated caution to drive carefully past horses.

There is an excellent map of the routes, and the system of control, the result of much experience, is perfect if it can be rigidly adhered to.

We should wish that the programme gave particulars as to where electric current could be obtained for recharging the batteries of electric vehicles, and we venture to suggest that other information as to hotels, petrol repairs, &c., such as is published in the "Automobilists' Guide" by King & Co., would be useful, and make the programme of events worth keeping for future reference.

The limit of speed in Scotland is 10 miles an hour, in England it is 12 miles per hour, in France the limit is 12½ miles through traffic and 18½ miles on the open road, and in America 12 to 14 miles.

The Judges' Committee, in arriving at their decisions, will give marks principally on the results of the trial, but will also take into consideration:—

(*a*) Price.
(*b*) Weight.
(*c*) Horse-power shown by performance.
(*d*) Persons carried, or load.
(*e*) Price in proportion to seating capacity occupied.
(*f*) Price in proportion to power of motor.
(*g*) Power in proportion to seats occupied.
(*h*) Power in proportion to weight.
(*i*) Mechanical efficiency as shown by hill-climbing trials.
(*k*) Simplicity of transmission.
(*l*) Accessibility of mechanism.
(*m*) Quality and sufficiency of speed gear.
(*n*) Easiness of adjustment.
(*o*) Steering gear.
(*p*) Brakes and brake gear.
(*q*) Igaition arrangements and apparatus.
(*r*) General design, mechanically.
(*s*) General design, appearance.
(*t*) Workmanship, especially of machinery.
(*u*) Condition of car at end of trial.
(*v*) Breakages and defects not previously mentioned.

Certificates will only be given in respect of vehicles which have made an average of not less than 8 miles per hour on the total trials, after deducting loss of time in controls, by tire troubles and by compulsory stops.

The rules are very similar to the rules issued for the 1,000 miles' trial, and as the ostensible object of the forthcoming 500 miles' trial is to ascertain the reliability of motor vehicles, it should be borne in mind that the 1,000 miles' trials in April of last year sufficiently demonstrated that point. These trials were held from April 23rd to May 12th—18 successive days—65 vehicles started, and over 50 vehicles successfully accomplished the 1,000 miles at an average speed of about 12 miles an hour; they were on exhibition in 10 towns where they stopped on the way, and ascended and descended in perfect safety such inclines as from Kendal to Shap Fell; the results were eminently successful and satisfactory.

We venture to recommend a much more exhaustive trial and analysis than is proposed, for improvement in detail only comes from such trials and analysis, and it is only by these means that real progress in this country and success in the industry will be attained; tests of efficiency before the trials, to enable the judges

the centre of the locomotive. The high tension switch is outside at the end where one transformer is placed, and the starting devices are in the corresponding space which the other transformer occu-

passengers 300 ft. higher, to the summit, by means of an electric elevator, upon which will be mounted a three-phase motor, carrying two pinions, working in racks on the side of the shaft. The

to obtain data as to the performance of each vehicle, such as brake horse-power required to propel the vehicle on the level and at set inclines—in other words, draw-bar pull, or its equivalent—giving the actual horse-power. The total weight, carefully taken before and after the runs, and such other particulars, would be most useful in estimating or corroborating the results obtained in actual trial on the rough roads, steep inclines, and under control, together with consumption of petrol for petrol cars, or water and fuel for steam cars, and electric energy for electric cars. All information as to construction of cars, size of wheels, speed of engines or motors, ratio of reducing gear, mechanical construction and mounting of engine, motors, &c., would be most acceptable to the carriage builder.

Now, a word as to electrically-propelled vehicles or electromobiles. The majority of the competitors will run petrol cars, and the reason is not far to seek. Petrol is easily obtainable, and there is thus no limit to the distance a petrol car can be run. Electric cars require their batteries recharged, and as there are still in this country many small towns where electric light is not yet laid on, this difficulty of re-charging has to be met. In the larger towns, fortunately, facilities are being provided for recharging. In the five days' routes set out electric current for recharging could be obtained at Glasgow, Edinburgh, Stirling, Ayr and Dumbarton; whilst at Callander, Lanark, Greenock and, we believe, other of the small Scotch towns on the routes, electric current could be obtained from the local mills or works having their own electric light plant, so that with a little enterprise there need not be any insurmountable difficulty for electric vehicles entering in the competition. We understand there are some firms entering, and we suggest, as we have done in a previous issue, that "watt-hours per ton mile" should be ascertained during the run of each such electric vehicle, as well as the "miles per cwt. of car," which, of course, is simple and easily calculated. Electric cars have many advantages over petrol and steam cars, and, with reasonable facilities for recharging their batteries, should come to the front.

THE CENTRAL STATION SUPERINTENDENT.

By J. H. VAIL.

The prize-winning paper, reprinted from the New York *Electrical Review*.

Coincident with the remarkable industrial development of electric lighting has grown the demand for men well versed in the art, men who have the necessary practical skill and technical knowledge combined with the other attributes that make them competent to fill the more advanced positions.

The kind of skill and knowledge necessary requires a broader familiarity with the several branches of engineering than is usually requisite to fit one for a similar position in other manufacturing lines. The superintendent of an electric lighting system has the oversight of so varied an assortment of modern appliances and operating methods that it is manifest that he should be unusually well acquainted with the characteristics and modes of operation of the improved types of steam and electrical equipments, and also have a thorough knowledge of underground and overhead systems of distribution. With the rapid growth of electric lighting there has been a corresponding advance in all the types of apparatus that are combined in a central station plant of the first class, while the increasing uses of current for lighting and motive power have so broadened the field as to involve the production and distribution of current of different characteristics, necessitating a very thorough acquaintance with the exact value of each type or system.

Unless one is personally acquainted with the many duties required of the superintendent, it is difficult to appreciate the numerous qualifications of a high order required. The intensity of application and the strenuous work frequently required from the superintendent are only rarely understood by the business management. The man's ability is judged according to the results he produces, and it is seldom that time is given to analyse the details whereby the results are obtained. It is expected that the man selected for so important a position will be of good moral character and strict integrity, therefore we will not dwell upon these points.

Executive Ability.—Executive ability should be the first requirement of a superintendent, for the reason that if he has practical experience and technical knowledge without capacity for organisation and management, he cannot successfully regulate the duties of the operating or constructing force.

His value to his company depends not alone on his personal knowledge of the various branches of his profession, any of which he may be personally competent to handle himself, but he must be capable of selecting and surrounding himself with a corps of competent subordinates, and of so supervising and directing their labours that he obtains from them superior results with the least expenditure of his own vital energy. Many who have technical knowledge and practical experience yet lack executive ability, and are, therefore, incapable of supervising or directing the work of others.

His own practical experience, his knowledge of human nature and a keen determination of the abilities of individual workmen will quickly enable him to measure the capacity of each subordinate and to decide to what limit each man can be depended upon. He thus proves his ability to perfect a working organisation and system of operation that will, in a large degree, leave him free from anxiety about details. In such an organisation each man knows when and in what manner his duties are to be performed, and emergencies are met and overcome with the least difficulty. Favouritism and political influence are responsible for placing many incompetent men in advanced positions.

The writer has personal knowledge of a man being placed as superintendent of an important station through favouritism. This man had no executive capacity, only a superficial theoretical knowledge, no technical education, and absolutely no practical experience. His instructions to subordinates were a constant subject of ridicule. His mistakes cost thousands of dollars, and yet, because of favouritism, he was for a long time retained, while competent and faithful subordinates were discharged on his recommendation. It cannot be a subject for wonder that, under such maladministration, a well-equipped station is not successful.

Practical Experience.—Practical experience should be the second essential requirement of the superintendent. He should be a man of proved capacity in this direction; which qualification is best obtained by actual labour in the ranks, or by long familiarity with accurate observation of methods of manipulation. An apprenticeship served in a good general machine works will be time well spent by a man who hopes to advance in this branch of electric lighting.

He should, primarily, have a genius for mechanical pursuits, and in the course of a reasonable term of service as a private he learns how properly to apply his technical training. He perceives how to analyse his theoretical knowledge and correctly apply it to practical work. He thus combines theory and technical training with practical experience, and becomes a master workman in the true sense. This kind of training develops quick perception, and in emergencies affords self-reliance and resourcefulness to decide promptly between methods and select wisely the best means.

The superintendent is recognised by both his superiors and subordinates as a master workman in his profession; having attained this standard, he has established a confidence in his ability that is not easily disturbed. It is possible to become well trained in technical knowledge even while in daily association with working conditions, and by many it is believed that technical training is thus more readily acquired, as practice and study are simultaneous. An experience of no little value is that to be obtained through the students' courses arranged by many of the large electrical manufacturing companies. This work is of a practical character, and, when diligently followed by an observant man, affords him a most excellent knowledge of the various types of generators and appurtenances and their characteristics. This course of training cannot fail to be highly appreciated in after years by those who have been so fortunate as to obtain it. It is but one of the many stepping-stones that assist in equipping a man for his chosen work, and it is here mentioned as a help, but not of vital importance.

Technical Knowledge.—Technical knowledge should be the third requirement of the superintendent. He should have the training of a mechanical and electrical engineer. The increasing complexity of the several mechanisms that are combined in the equipment of a large central lighting station, and the diversity of the systems of transmission, distribution and methods of utilisation of electric energy, all require for their proper supervision a well-trained, active and energetic mind. A thorough technical education provides the superintendent with a ground work upon which he builds his career of usefulness. The superintendent must be well read in the technical literature relating to the several branches of his work. He requires to be well informed and up-to-date on all matters pertaining not only to improvements in the several types of apparatus or mechanism, but also in the best methods of securing results. The valuable reviews of current technical literature afford opportunities for keeping pace with the most advanced methods, as well as indicating salient points worthy of careful analysis.

The superintendent should be a thinker, as the work frequently demanded of him will require all his skill and resourcefulness to meet and control the difficulties. How often do we find that the real difficulties to be overcome are those which are brought about by the introduction of combination of conditions which the ordinary rules have not anticipated. And very often the actual working conditions are difficult of precise determination.

There has been a marked advance in recent years in technical engineering education, and there is yet much to be desired in the direction of bringing the educational courses into closer conformity with actual working conditions. It is believed that the time is not far distant when the student will, during his educational course, obtain his theoretical and technical instruction combined with actual working conditions. He will then be prepared to start out upon his business career at a higher level, and will add from three to five years' time to his earning career.

Legal Knowledge.—It cannot be expected that the superintendent will be learned in much of the law; yet it is quite important that he should have a fair knowledge of the laws governing the employment of labour, the rights of his company under its charter and of the city ordinances; the liability of his company, as a common carrier, to serve the public; the liability of his company because of accidents to employés or to the public.

He should be well informed in the preparation of contracts and specifications. With a fair knowledge of the salient points, he will the better understand how to avoid legal entanglements pertaining to his department of the business.

(To be continued.)

Fleetwood.—Mr. C. H. Wordingham, M.Inst.C.E., has been appointed by the Board of Trade to act as electric inspector under the Fleetwood Electric Lighting Order.

Prof. Hudson Beare, B.Sc., M.Inst.C.E., M.Inst.Mech.E.

be attained; tests of efficiency before the trials, to enable the judges

CURRENT SPECIFICATIONS.

LXXIV.—WORCESTER EXTENSIONS.

Summary.

Extent of Contract.—Supply and erection of generating plant for use in the new station, Hylton Road, Worcester.

System Adopted.—Direct current three-wire system, with 230 volts between centre and outers for lighting and 500—550-volt circuits for traction.

Boilers.—Three to be provided, of water-tube type, Babcock and Wilcox or other approved make, each to have a heating surface of 3,140 sq. ft. and to be capable of evaporating 11,000 lbs. of water per hour.

Superheaters.—To be fitted to each boiler, capable of raising the temperature of steam 120° above that of saturated steam at the working pressure of 180 lbs. per square inch.

Mechanical Stokers.—Of Babcock & Wilcox chain grate type or other approved type.

Economiser.—Green's type, 288-tube size, with all latest improvements and motor-driven scraper gear.

Feed Pumps.—Messrs. Weir's make, two in number, each to pump 2,500 gallons of water per hour against a pressure of 180 lbs.

Engines.—Three to be provided, triple-expansion three-crank type, each for direct coupling to dynamos, and capable of output of 350 I.H.P. at 300 revolutions per minute when working condensing with 175 lbs. per square inch.

Condensers.—To be of Messrs. Korting's "Ejector" pattern, No. 30 size.

Dynamos.—Four to be provided, two to give either as shunt or as compound-wound machine 250 KW., two to be shunt-wound only and give 125 KW. each. The two latter machines to be coupled to the same engine.

Voltage of Dynamos.—250-KW. machines, 460 to 550 volts as shunt machines, 500 to 550 volts as compound machines; 125-KW. machines, 230 to 260 volts as shunt machines.

Specified Overload.—Twenty-five per cent. for half an hour without injurious heating, and with absolutely sparkless commutation.

Permissible Temperature Rise.—Not to exceed 70° F. after a 24-hour full-load run.

Specified Efficiency.—93·5 per cent. at full load, 91·5 per cent. at half load.

Specified Steam Consumption.—With 155 lbs. per sq. in. steam, a vacuum of 25 in. and 120° F. superheat:—Full load, 24·3 lbs. per KW.-hour; three-quarter load, 25·8 lbs. per KW.-hour; one-half load, 26·7 lbs. per KW.-hour; one-quarter load, 28·9 lbs. per KW.-hour.

Motor Alternator Set.—To consist of alternator direct coupled to dynamo and coupled through Snyer's clutch to a Belliss engine to be removed from present works.

Output of Set.—75 KW. of either dynamo or alternator, direct currents at 460 to 550 volts, alternator at 2,000 to 2,200 volts 100 periods. The alternator may be run either as generator or motor with one pole earthed.

Booster.—To consist of three machines, motor in centre, and booster on either side, to each generate 7·35 KW., 105 amperes at 70 volts. The motor to be capable of driving both boosters when working at full load.

Condenser Pumps.—Two motor-driven centrifugal pumps, one to deliver 550 gallons per minute against a head of 45 ft., and the other 750 gallons per minute to the same height.

Switchboard.—To be of standard type, with instruments as specified, suitable for both lighting and traction working.

Overhead Crane.—To lift 10 tons, to be worked by hand, and to be suitable for a span of 32 ft. 4 in.

Accumulators.—250 cells to be supplied, each cell to have a capacity of 630 ampere-hours when discharged at rate of 105 amperes.

Specified Dates of Completion.—Boiler section seven months, steam dynamos and cells eight months, crane six months, rest of contract seven months.

Penalty for Late Completion.—One per cent. per week of contract price for each section late.

Terms of Payment.—75 per cent. of value of work executed and plant delivered on site on monthly certificates of engineer until value of money retained by Corporation is equal to 10 per cent. of contract price. Half this sum to be paid on completion, rest 12 months later.

Period of Maintenance.—Twelve months from date of completion.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages to be Paid to Workmen.—Standard rates to be paid.

Sureties.—Two to be provided, to be bound jointly and severally in sums equal to total contract price.

Arbitration Proposals.—See comments below.

Date for Receipt of Tenders.—August 23rd, 1901.

This specification has been prepared by Mr. C. J. Sutherland, the city electrical engineer, and provides for the supply of generating plant for the new station which the Corporation are building in Hylton Road. It will be noticed that direct current plant is asked for, although the present station is entirely equipped with alternating current plant.

There is no doubt that one of the reasons for this change is the probable traction load, but as a three-wire lighting system is also provided for, it appears that in the opinion of the technical adviser to the Corporation that system has advantages over the one at present in use. The provision of a 75-KW. motor-alternator, which may be used either as alternator driven from direct current side, dynamo from alternator side, or through a Snyer's clutch coupling from a Belliss engine to generate either class of current, enables a certain amount of interchangeability to be obtained. It will be remembered that the present station is situated some distance from the city and is partly driven by means of water power.

The designer of the station evidently looks upon economical production of power as the principal consideration, and provides for high pressure boilers, superheaters, triple-expansion engines and condensers. The steam consumptions demanded at light loads are very low, and we shall be interested in learning whether they are actually obtained.

In specifying the accumulators, it is stipulated that the fall in pressure in the cells after a discharge at a certain given rate shall not exceed 10 per cent. We think that it would have been better to state the voltage, as the commencing voltage may vary according to the rate at which the cells have been charged and the time which has elapsed since the charging took place.

A guarantee must be given that the capacity of the cells measured in kilowatt-hours shall be 90 per cent. of specified output at end of three years, and extra sums stated for which this guarantee will be extended for five and seven years.

The arbitration clauses need careful perusal, since they are in a certain degree contradictory. Thus Clause 14 in the general conditions permits an appeal to arbitration, notice of which is given within 72 hours of the engineer's decision, upon any fiat of the engineer regarding the rejection of materials or the amending of defective workmanship.

Clause 34, which is headed "Disputes," states that *any* dispute or difference relating to the qualities, quantities, descriptions, or manner of work done or executed under the contract shall be referred to, and finally decided by, the engineer without any right of appeal by the contractor.

We recommend that all tenderers stipulate that the usual clause, as agreed upon by the Municipal Electrical Association and the Electrical Plant Manufacturers' Association, be inserted in the final contract, so as to avoid any misunderstandings as to the meanings of the above clauses. Standard rates of wages, as current in the district, are to be paid, and local conditions of labour observed for the different districts in which the work will be carried out.

THE NEW WESTINGHOUSE WORKS AT MANCHESTER.

In our last issue we were able to give a few general details of the works which are being built and equipped at Rugby by the British Thomson-Houston Company. This week we are able to record a step forward in connection with the construction of the manufactories which the British Westinghouse Electric and Manufacturing Company has for some time past been engaged upon at Trafford Park, Manchester. The step to which we refer was the laying of the commemorative corner stone on Saturday last by the Lord Mayor of London, assisted by the Lord Mayor of Manchester.

A large party of guests were conveyed down from London by special train on Saturday morning, others joining the party after visiting the site of the new Linotype works for the laying of a foundation stone by the Lord Mayor of London. At the Westinghouse ceremonial the Lord Mayors were supported by Alderman W. Vaughan-Morgan and Mr. Sheriff Lawrence, M.P., and the others present included Messrs. C. W. Benson, deputy chairman of the British Westinghouse Electric and Manufacturing Company, Lemuel Bannister, Ph. Ferd Kobbe, and J. H. Lukach (executive committee), J. Annan Bryce, J. F. Mason, A. E. Scanes (secretary), W. H. Wells (business manager), H. S. Lond (works manager), J. C. Stewart (building manager), G. W. Beckwith and W. H. Penton (Dorman, Long & Co., Middlesborough), J. Lockie (Leith), Walker Bros. (Wigan), J. Levinstein, W. H. Fowler, Vaughan, C. H. Wordingham, G. Fell, R. A. Armitage, C. J. Galloway, Broadbent, A. B. Mountain, and S. B. Cottrell.

The proceedings were opened by Mr. C. W. Benson, who, on behalf of the chairman and directors of the company, gave a very cordial welcome to the Lord Mayor of London and the Lord Mayor of Manchester, to the Sheriffs and the other guests. He said that in entering on the undertaking which they had begun there at Manchester, the company had had not only the benefit of English knowledge, and American knowledge, but even of Scotch knowledge, and they hoped to see the successful completion of the works of which they had met to lay the corner stone, and to see them a success financially. He then handed the Lord Mayor of London a trowel, and the Lord Mayor of Manchester a mallet.

After the necessary operation had been carried out, the Lord Mayor of London declared the stone to be well and truly laid, and expressed the hope that there would be built upon it a superstructure which would be honourable alike to the builders and to those who had promoted that very great undertaking.

The Lord Mayor of Manchester said that he had been told that the company was an English and American combination—English mainly. That being so, he trusted and believed that the undertaking would be a financial success, and find employment for a large number of hands.

Mr. Sheriff Lawrence, M.P., said he had been deputed, under somewhat exceptional circumstances, to speak on behalf of the directors of the British Westinghouse Electric and Manufacturing Company, of which he himself was a director. The honoured president of the company, Mr. George Westinghouse, a man of international fame, was unable to be there. He had a genuine excuse, for Mr. Westinghouse was in a state of ill-health from excessive overwork at that time, and his medical adviser had wished him to go into Cumberland for two or three weeks. Under those circumstances it devolved upon him (Sheriff Lawrence), in the absence of his colleague, to move a vote of thanks to the Lord Mayor of London and the Lord Mayor of Manchester for coming there to lay the corner stone of that great industry. That development was a great and new departure in the manufacture of electrical machinery and engines, and the capital which had been invested in those lands and buildings, and would still be invested, was entirely British. It had been found in London by leading capitalists, from Lord Rothschild downwards. He saw on that platform Mr. Lukach, who, with Lord Rothschild, had been instrumental in finding the capital. While that enterprise in its inception was essentially American, the details and developments would be entirely in British hands. They couldn't have started the business themselves, as they wanted a great many patents which were in American hands. Mr. Westinghouse said he would endeavour to lock hands with them and to rear on the soil of Old England an industry which would be a profitable one, and bring profit to all concerned. From those works they hoped to send out electrical machinery which would astonish the world. Already contracts for great and important works had been secured, and would be carried out as soon as the works were ready. They had committed themselves to an expenditure of a sum of not less than a million and a half sterling, and possibly another half-million might be wanted before they had carried out that magnificent design of Mr. Westinghouse's; they believed that they were going to get a good return on that money, not only for the shareholders, but for the industries of Lancashire, and that in a short time, if they did not surpass, they would at any rate equal the finest productions of the works of America and Germany. He thought they owed a great debt to Mr. Westinghouse and those who surrounded him for bringing that great industry into existence, and he hoped his example would be followed by others. This old country, much as they loved it, needed a little stirring up at times, and he thought they were going to get it if Mr. Westinghouse remained among them. The designs of those works were due to Mr. Rodd, engineer to the Pennsylvania Railway Company, who had designed the works of the company in America. Their works at Pittsburg gave employment to 15,000 hands. Those works (at Manchester) were designed to employ 5,000 men. Mr. Westinghouse had picked out a band of young men and sent them out at his own expense to the works at Pittsburg, so that they could learn the methods of working, and in a few years when they came back with the training they had had they would be put in as foremen of those works. When they started the works they would start one of the finest industries in the world. He had much pleasure in moving that their thanks be given to the Lord Mayor of London and the Lord Mayor of Manchester for their kindness in coming there that day.

Mr. R. H. Porter, chief of the United States Census Department, remarked that when he came over to England eight or ten weeks ago he found that, for some reason or other, that he had not been able to discover, there was an epidemic of pessimism passing over this island of theirs, that they were manufacturing all kinds of bogies and boojams against British trade. He thought a reasonable amount of pessimism was good Some of them had read a recent novel by David Harum. He said in the book that a reasonable amount of fleas was good for a dog, for it only kept him from brooding over the fact that he was a dog. He thought a reasonable amount of pessimism might be good for this country, and might be good for Germany, for it only prevented them from thinking about it. If there were any pessimism, he thought they would agree with him that it did not exist in that district. He had had to do more or less with the weighing of what statisticians said of the means of the country, and he had simply got to say that what he had seen in England and in that district completely nonplussed their political economists. He would say that British experience and British Conservatism, interwoven with the ingenuity and enterprise of Americans, would put up a hard front for the rest of the world to compete with. He seconded the vote of thanks for the Lord Mayor of London.

The Lord Mayor of London, in responding, said that all those who had accompanied him from London wished that great undertaking every possible success in the future. When they found, as Mr. Porter had so properly said, a combination of American intellect and British capital, they were sure it stood on a sound foundation, and they might feel with pleasure that at no distant date the directors of that company would have the satisfaction of seeing the rewards of their labours and of paying good dividends to their shareholders.

The Lord Mayor of Manchester also acknowledged the vote of thanks. He added that it was highly gratifying to hear that some young Englishmen had been sent over to the Westinghouse works at Pittsburg to learn the work. He hoped that when they came there to those works they would work with success, and that the old men would do their very utmost to learn and carry out the principles which those young men had learned. If they did the results would be more than doubled and that establishment would go on and prosper. No doubt the wages paid would be a great service to the district; 5,000 people would mean a very large amount of wages paid. He hoped everything would go on satisfactorily, and that other firms would come there and establish works.

Mr. J. C. Stewart informed the gathering that the main building of the works was 450 ft. in width and 1,000 ft. in length.

The visitors now proceeded to the inside of the large building which will serve as the fitting shop. A portion of this had been partitioned off and highly decorated with flags and flowers. Here the visitors took tea. Afterwards most of them returned to Manchester by conveyances which were provided for them.

The new buildings stand within about 130 acres of Trafford Park estate, which the company have acquired. The buildings run almost due north and south, the north ends forming the front. The works will comprise six rectangular buildings, arranged side by side in the order most convenient for securing straightforward work in the manufacture of the machinery in the many operations from foundry to finish. On the extreme east is the iron foundry, 170 ft. wide by 580 ft. long. Next come the brass foundry, malleable iron foundry, pattern shop, steel foundry and forge. The machine shop lies next, the building being 430 ft. by 900 ft. This building is divided longitudinally into bays and will contain the most modern machines of all kinds.

In all, some 5,000 workmen will be employed. Most of these will reside in houses built by the Trafford Park Dwellings Company, Limited, who hold 120 acres of land near the works, on which from 2,500 to 3,000 dwellings will be erected. About 3,000 workmen are now employed in the erection of the buildings; 27 miles of railway track have been laid down and are in use. Some 15,000 tons of steel, which is being supplied by Messrs. Dorman, Long and Co., Middlesbrough, and 10,000,000 cubic ft. of timber will be used in the erection of the buildings. The entire works will be devoted to the manufacture of the different types of Westinghouse electric power machinery, including dynamos and motors, tramway and railway equipments, rotary converters, transformers and switchboards, and to the manufacture of gas engines, the Westinghouse three-cylinder gas engine being a speciality. The larger sizes of these engines will be built up to 1,500 H.P.

PARLIAMENTARY COMMITTEES.

London United Tramways Bill.

On the 24th ult. a Select Committee of the House of Lords commenced the consideration of the Bill of the London United Tramways Company, under which powers are sought to make various extensions of the company's lines in the South-western district of London; and to convert part of the present horse tramways into electrical lines.

The Duke of Northumberland presided, and before commencing the inquiry, said that when he was asked to act as chairman of the Committee he had no idea that one of the opposing parties was the Heston & Isleworth District Council. As he was a proprietor in the district some of the parties might object to his taking any part in the inquiry, although he need hardly say he was quite unbiassed.

Mr. Balfour Browne, K.C. (who with Mr. Fitzgerald, K.C., and Mr. Lewis Coward, K.C., appeared for the promoters) said that there could be no possible objection to the noble Lord acting as chairman, for as a matter of fact the opposition of the Heston and Isleworth District Council had been withdrawn.

Proceeding to open the Bill, Mr. Browne said that the length of tramways either constructed or authorised by the company was 40 miles, and of that number 16 or 17 were at the present time being worked by electric traction. The proposed extensions were almost entirely in the county of Surrey, and would be of the greatest possible public convenience. At the suggestion of the local authorities one or two of the routes had been slightly modified to meet their views. With regard to the question of electrolysis, counsel referred to the great mass of expert evidence which was given on the subject before the Committee of the House of Commons (which appeared in the Electrical Review of June 28th), and pointed out that the matter had been thoroughly thrashed out and the special clause asked for by the water companies for the protection of their mains had been refused by that committee. He contended that the water companies were afforded ample protection by the Board of Trade clause inserted in the Bill, and objected to the water companies appearing before that committee on this question.

The formal objection of Mr. Balfour Browne led to some discussion, and Mr. Baggallay, K.C., argued that the water companies had a right to be heard before the Lords' Committee.

The Committee, having considered the point, said they thought they must admit the evidence of the water companies.

Mr. James Clifton Robinson, the first witness, said he was managing director and engineer to the promoting company. The company opened their first lines, eight miles in length, which ran from Hammersmith Broadway to Kew Bridge, from Shepherd's Bush to Goldhawk Road, and from Shepherd's Bush to Acton, in May. On each of the four days, Easter Monday, Whit Monday, Sunday, July 14th, and Sunday, July 21st, the company carried nearly a million passengers. In the early hours of the morning they carried passengers at about a farthing a mile. The first extension the company sought under the Bill was a line which made a physical junction with the company's authorised tramway at Hampton Wick and then passed across Kingston Bridge, through Kingston to Malden, with a spur along the Richmond Road to the northern boundary of Kingston, another spur from Richmond Road passing along King's Road to Richmond Park, and a third spur from London Road, Kingston, to Kingston Hill. That line was not opposed. Another line would run from London Road, Kingston, *vid* Eden Street and Claremont Road to Surbiton Station, and thence along

Victoria Road, Brighton Road, Portsmouth Road *vid* Winter's Bridge and Thames Ditton to East Molesey, where it crossed Hampton Court Bridge and effected a physical junction with the company's already authorised lines at Hampton Court on the Middlesex side. There would also be connections from this line to Surbiton and Hook. Then there was a line from Hammersmith Broadway (where there was a junction of the existing lines of the company) which would cross Hammersmith Bridge and extend a short distance into Barnes. The scheme would involve £91,700 in street improvements, of which £20,000 was allocated to widening the bridges at Hampton Court and Kingston. The estimate of the permanent way construction was £169,900, making a total of £260,000, exclusive of outlay on electrical equipment. The whole of the lines would be worked electrically from one generating station at Chiswick. When the company's scheme was complete and in full operation he believed they would carry from 150,000,000 to 200,000,000 passengers a year.

Mr. E. J. Halsey, chairman of the Surrey County Council, gave evidence in support of the Bill. He said his Council had considered the question of tramways, and a majority came to the conclusion that they would be their own light railway authority, but as they had not the necessary two-thirds majority, they could not proceed further with the particular scheme before them. After discussion the Council decided that, if they were not to be the authority themselves, the best thing they could do would be to support a scheme which would be homogeneous.

The Committee then adjourned.

On the Committee resuming on 25th ult., Mr. Robinson, the managing director of the London United Tramways Company, was re-examined by Mr. Fitzgerald on the question of the danger likely to arise from the use of electric traction on tramways as opposed to horse traction. He said he felt confident that if the number of accidents occurring on electric tramways were compared with the number of passengers carried, the average would be found to be very infinitesimal.

A large amount of local evidence was then given in favour of the Bill, among the witnesses being Mr. Bull, M.P., who said that considerable inconvenience had resulted to the inhabitants of Hammersmith owing to the want of sufficient facilities for getting to Barnes, Mortlake, and Richmond. At present the only means of locomotion was the omnibus service, but he did not consider that at all satisfactory, and he felt sure that the inhabitants of the district would greatly prefer electric tramways as proposed in the Bill.

Mr. Skewes Cox, M.P., also spoke as to the local feeling in favour of the extensions, and said that personally he considered the connection across Hampton and Kingston Bridges the most important part of the scheme.

The Committee at this point cleared the room, and after deliberating in private for a considerable time, the Chairman, upon the readmission of the parties, said he had to announce that the Committee had come to the conclusion that the Hammersmith line was not proved, and therefore they did not propose to hear any opposition to it. They would, however, be prepared to hear the evidence in opposition to the other proposed extensions.

Mr. Fitzgerald said he thought he ought to inform the committee that the promoters had come to an agreement with the London County Council as to the Hammersmith extension.

The Chairman replied that that did not in any way modify the decision of the Committee.

Evidence was then given on behalf of the Middlesex County Council by Mr. H. D. Wakelan, the engineer and surveyor to the Council, who said that the proposed contribution towards strengthening and widening the bridges was not sufficient, and the view of his Council was that it would not be safe to take the tramways over Hampton Court Bridge unless it was reconstructed.

Lord Robert Cecil, for the Middlesex County Council, asked the Committee, if they decided that the tramways should be taken across the bridges, in the public interests it should only be on such terms as would secure to the County a fair and adequate contribution towards the cost of the improvements which would be entailed.

Evidence was then given on behalf of the frontagers in Kew and Richmond as to the damage which a tramway would inflict upon their property, and Sir James Szlumper, the Mayor of Richmond, having given evidence on behalf of the Corporation against the scheme, the Committee adjourned.

On resuming on 26th ult., evidence was tendered by Sir Whittaker Ellis, Bart., M.P., who asked the Committee not to grant the proposed extensions to Kew. He said he had taken a great interest in tramway matters for many years, and in his opinion electric tramcars spoiled the use of the roads for horse traffic. If the scheme were allowed it would very seriously injure the residential property along which the trams would run.

Sir J. Szlumper spoke as to the present railway facilities to Richmond, which, he said, were in his opinion quite sufficient for the needs of the locality.

Mr. Littler, K.C., having addressed the Committee on behalf of the Richmond Corporation, Mr. Fitzgerald replied on behalf of the promoters, and said that with regard to the question as to the widening or reconstruction of Kingston and Hampton Bridges, terms had been satisfactorily settled with the Middlesex County Council.

The Chairman said he had not consulted the Committee, but he might say that that question of bridges appeared to him to be a very serious one.

Mr. Fitzgerald said the arrangement was that the promoters had agreed to contribute £10,000 towards the alteration or reconstruction of each of the bridges as a *minimum*, but supposing the cost should largely exceed that amount they had agreed to contribute one-third of the total cost. The only point left to be dealt with was the proposed electrification of the tramway from Kew to Richmond, and there the frontagers could not be damaged by the scheme, because the Richmond Corporation had stated their intention of converting the present horse tramways into electric lines if they passed into their hands.

After consulting for some time in private, the Chairman said the Committee found that portion of the preamble which referred to the tramway from Kew to Richmond not proved. The rest of the preamble was proved with the inclusion of the clause relating to the Chelsea Waterworks Company. The other clauses were then adjusted.

Tramways Provisional Order.

Tramway Orders Confirmation Bills, Nos. 3 and 4, were before the House of Commons' Committee on Unopposed Bills, on Wednesday last week, and were ordered to be reported for third reading. The Orders relate to Coatbridge, Folkestone, Glossop, Hopeman, Weston-super-Mare, Pontefract, Cheriton, Colchester, Hyde, Littleborough, Middleton, and Chadderton. Particulars of undertakers have previously been given in the Electrical Review.

Portmadoc, Beddgelert and South Snowdon Railway.

The above Bill came last week before Mr. Lowther's House of Commons' Committee on Unopposed Bills. The object of the Bill is to construct a railway from Portmadoc to the foot of Snowdon on its south side. The railway will run through the Pass of Aberglaslyn and the Vale of Gwynant to the top of Lake Gwynant. For the purpose of generating electrical energy to work the railway the waters of Llyn Llydaw and Llyn Teym will be impounded.

There were several petitions against the measure, on the ground that the natural beauties of the locality would be interfered with.

Sir Douglas Fox, the engineer of the scheme, said it was quite a misapprehension to think the scheme would interfere with the scenery, the only effect being that the two mountain tarns would be lowered 2 or 3 in., but the water abstracted would be returned to the stream.

The Chairman announced that the Committee had decided to pass the Bill and leave it to the House of Commons to deal with any opposition.

The Bill came before the House of Commons on Tuesday, when an amendment to omit a clause enabling the company to utilise the waters mentioned, was defeated by a very large majority.

Loch Leven Water Power Bill.

The Loch Leven Water Power Bill, which passed a House of Commons' Committee a few weeks ago, was before Earl Waldegrave's House of Lords' Committee on Thursday and Friday last week. The Bill is promoted by the British Aluminium Company for the purpose of taking the waters from Loch Leven for generating electricity and other purposes. The opposition came from Mrs. Lucy, who owned property affected, and her sporting tenant.

Mr. Littler, K.C., having opened the case, called

Mr. Wallace, K.C., chairman of the Aluminium Company, who stated that while the company were not philanthropists, they wished as far as possible to develop British industry, and believed that important industries could be developed if the powers sought were granted.

Lord Kelvin gave evidence that in his opinion the scheme was well devised. He felt disappointed that the British Aluminium Company had not been a greater success than it had, but each year showed an improvement.

Further evidence in support of the Bill was called, and an adjournment was made to see if the parties could come to an agreement. This they failed to do.

Mr. Erskine Pollock, K.C., addressed the Committee for the petitioner, and submitted that there was no evidence that the ground which had been taken for factories would ever be used for that purpose.

The Committee found the preamble of the Bill proved.

Pontypridd Tramways.

On 2nd inst. the House of Commons' Committee, presided over by Mr. Jeffreys, concluded the consideration of the Provisional Order Bill, confirming orders granted by the Board of Trade for the construction of tramways. The only order opposed was that of the Urban Council of Pontypridd, and the opponents were the Taff Vale Railway Company. The Bill has already passed the House of Lords.

It was stated by Mr. Ram, K.C., that the scheme had the enthusiastic support of the inhabitants of the district, as it was felt that a tramway would be a great boon. He submitted that the railway company would not be injured, for it was primarily a mineral line, and carried few passengers. The estimated cost of the tramway was £41,000.

Evidence having been called,

The Chairman said the Committee thought the roads through which the line was proposed should all be widened to 24 ft.

Mr. Ram said that if this was insisted upon it would kill the scheme.

Mr. Fitzgerald, for the railway company, argued that his clients would be very hardly treated if the tramways were allowed. The company had recently opened up a short line for colliers, and what little passenger traffic they had they would be deprived of. They considered that the tramways would never pay, and consequently

the railway, which owned a lot of property, would be called upon to pay one thirteenth of the loss.

The Committee found the preamble proved, subject to all country roads being widened to 24 ft., and the other roads to be widened.

Watford Tramways.

On Tuesday the Watford Tramways Bill was before the House of Commons' Committee on Unopposed Bills, and was ordered to be reported to the House for third reading. The Bill incorporates the Watford and District Tramways Company, and authorises the construction of over eight miles of tramways and the taking of land for the erection of a generating station.

City and South London Railway.

This Bill, which authorises an extension of time for the completion of certain works, passed the House of Commons' Committee on Unopposed Bills on Tuesday, and was ordered to be reported to the House for third reading.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

14,844. "Shunt telephonic transmitting and receiving key." J. Wright. July 22.

14,864. "Improvements in or relating to electrical wall plugs." S. A. Hunter. July 22.

14,893. "Improvements in or in connection with tramway and other cars that are propelled by electricity." J. Hunter, E. Griffiths and W. F. Green. July 22.

14,897. "Improvements in electric meters." P. Rieunier. July 22.

14,901. "Improvements in trolley arms for electric tramcars and like vehicles." A. Bergtheil. July 22.

14,918. "Improvements in couplers for connecting together the ends of wires, conductors and the like." E. Fischer-Schaad and H. Schneider. July 22.

14,919. "Improvements in wireless telegraphy." H. Shoemaker and G. P. Gehring. July 22. (Complete.)

14,930. "An improved safety device for trolley poles and the like used in connection with overhead electric railways and tramcars. J. Parsons. July 23.

14,932. "Improvements in and relating to electric meters." W. McWhirter. July 23.

14,943. "Improvements in electrical brush-holders." T. Wilson and A. Wilson. July 23. (Complete.)

14,946. "Improvements in and connected with electrolytic apparatus." M. Haas. July 23. (Complete.)

14,963. "Improvements in electric arc lamps." J. H. Heany. July 23. (Complete.)

14,967. "Improvements in apparatus for refining metals by electrolysis." H. H. Lake. (A. G. Betts, United States.) July 23. (Complete.)

14,996. "Improvements in electric motors." J. H. Heany. July 23. (Complete.)

14,997. "Improvements in electric motors." J. H. Heany. July 23. (Complete.)

14,998. "Improvements in electric arc lamps." J. H. Heany. July 23. (Complete.)

15,004. "Improvements in and relating to surface contact systems of electric traction." G. C. Marks. (La Société Rouaix Volatron et Cie, France.) July 23.

15,041. "Improvements in trolleys for electric tramways and the like." S. Kempner. July 24.

15,045. "Improvements in electric arc lamps and in optical apparatus in which electric arc lamps are employed." R. C. R. Evans. July 24.

15,048. "Improvements in and relating to electrical current regulating and controlling devices." H. Herberts. July 24.

15,069. "An improved lead fuse for electrical plant." F. H. Krebs. July 24.

15,087. "Improvements in electric percussion drills." F. H. Loring. July 24. (Complete).

15,118. "Improvements in lampholder switches for electrical incandescent lamps." H. W. Cox. July 25.

15,130. "Improvements relating to electric stoves or heaters." A. E. Greville. July 25.

15,146. "Improvements in trolley stands for electric cars." G. C. Marks. (E. J. Parker and A. S. Paton, U.S.) July 25. (Complete.)

15,149. "Improvements in and connected with the protection or covering of underground cables." O. Wilhelmi. July 25. (Complete.)

15,155. "Improvements in and relating to conduits for carrying electric conductors." H. Hirst and F. Boyes. July 25.

15,167. "A life guard for electric and motor cars for the safety of the public." G. Richards. July 26.

15,190. "Improvements in systems of control for electrically-propelled trains." The British Thomson-Houston Company, Limited. (F. E. Case, United States.) July 26. (Complete.)

15,192. "An improved secondary battery for electric lighting or other purposes." J. W. Elliott and G. H. Jefford. July 26.

15,195. "Improvements in supporting conductors on conduit systems of electric railways." W. Chapman. July 26.

15,196. "An improved electric safety lamp for miners' use." J. W. Elliott and G. H. Jefford. July 26.

15,206. "Improvements in safety devices for overhead conductors for electric traction, lighting and the like." H. W. Cafferata, (G. W. Gaskell and J. A. Kerr.) July 26.

15,239. "Improvements connected with electrical cut-outs and partly applicable to electrical switches." E. E. Bartlett. July 27.

15,242. "Automatic self-righting motion for swivelling trolley wheels on electric tramcars." T. B. Bibby and F. E. Bibby. July 27.

15,248. "Improved electrically illuminated travelling timepiece." Major A. Roswell. July 27. (Complete.)

15,258. "Improved means for raising and lowering arc lamps." J. T. Irwin and Willans & Robinson, Limited. July 27.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1899.

21,990. "Improvements in and connected with grips for electrical apparatus." H. Oppenheimer. (Actiengesellschaft Mix & Genest.) Dated November 3rd, 1899. The two conical bodies for gripping a flexible conducting cord in an electrical apparatus such as a lampholder are held between the casing and a shoulder in a screw cap, a tabular extension of which has a smooth outwardly turned edge to avoid chafing.

21,991. "Improvements in and connected with porcelain interiors for electric incandescent lampholders." H. Oppenheimer. (Actiengesellschaft Mix & Genest.) Dated November 3rd, 1899. A porcelain insulating body for a bayonet holder is made with an S-shaped ridge, the middle of which is highest, forming recesses to receive the metal parts. A straight groove is formed across the face of the insulator, between the spring plungers. In a modification, more than one ridge and groove are interposed between the metal parts.

22,016. "Improvements in electrical switches for telephonic systems and other purposes." M. Byng and F. G. Bell. Dated November 3rd, 1899. Relates to means for securing in telephone systems, &c., that a switch arm is properly upon its contact stud. The contact arm is pivotted to a plate, suitably supported on a switchboard, and rubs over contacts. The plate has sunken hemispherical recesses corresponding to the contacts, and a ball is pressed by a spring and falls into a recess with an audible clack. In a sliding switch, a pointer serves as an indicator.

22,534. "Improvements in means for generating alternating electric currents." The British Thomson-Houston Company, Limited. (C. P. Steinmetz.) Dated November 11th, 1899. Dynamos, alternating current:—Consists in generating alternating currents by the rotation of a closed conductor in synchronism with and in inductive relation to a magnetic field of force due to the agency of alternating currents. In the arrangement shown, single-phase alternating currents are supplied by the generator to the primary circuit of an induction machine, and the closed-circuit armature is rotated synchronously by means of a driving belt. The primary current is thereby brought partially into phase with the primary electromotive force, and the mechanical energy supplied to the machine is converted into electrical energy. The closed-circuit armature may have a practically uniform magnetic reluctance, as in the form shown, or a shuttle form of armature may be employed. The invention may also be adapted to a multi-phase system. 5 claims:

22,536. "Improvements in electrical distribution and in starting rotary electric converters." The British Thomson-Houston Company, Limited. (W. B. Potter). Dated November 11th, 1899. Relates to systems of distribution with rotary converters, and to the starting of the converters. A small generator driven by an induction motor is provided for producing a direct current for starting the converters one at a time. The induction motor, supplied with a three-phase current drives a small generator having a regulable resistance in the field coils and a resistance for varying the current supplied to either of the converters. Switches are so arranged that either converter may be connected with the generator, and other switches for connecting the converters with the direct-current bus bar. In a modified arrangement the starting resistance is dispensed with, and the generator has two armatures having separate sets of switches, so that they may be connected either to the armature or the field coils of the converter. 7 claims.

22,609. "Improvements in the electric lighting of railway vehicles." E. R. Hill. Dated November 13th, 1899. (Date under International Convention, April 14th, 1897.) The system is particularly adapted for lighting vehicles on electric railways in which the three-wire system is employed, the supply conductors being in sections and alternately connected to the positive and negative mains. The lamps are arranged in two groups, and two sets of collectors are employed. In the arrangement the car runs on the neutral track. The sectional conductors are connected alternately to the mains, and two pairs of shoes are employed, the space between each pair being less than the space between the conductors. The shoes are connected to the two sets of lamps and the motors. Thus one set of lamps is always in circuit, and the motors are alternately in series and parallel. 3 claims.

22,615. "An improved safety device for starting switches of electric motors." A. J. Attenberg. Dated November 13th, 1899. Switches for motors.—An electro-magnetic device is provided so that the switch arm cannot be moved farther on when the current has reached a predetermined maximum. 2 claims.

22,666. "A new or improved chemical generator of electricity." E. L. Anderson. Dated November 14th, 1899. Relates to batteries in which carbon is the element consumed, and consists in the use in such batteries of hydrofluoric acid as the electrolyte. 7 claims.

22,679. "Improvements in or relating to electro-magnets for use in relays, sounders, and other electro-magnetic apparatus." J. L. Cutler. Dated November 14th, 1899. Electro-magnets for use in relays, sounders, &c., are formed with the magnetic circuit sub-divided in various ways. In one arrangement the sheathed magnet has its sheath separated from the core by a mica plate, and at the same time is divided longitudinally by openings. The armature is also formed with three magnetic plates corresponding in shape to the two halves of the sheath and the core. 7 claims.

22,710. "Improvements in apparatus for the electrolytic extraction of zinc." (S. Stepanov.) Dated November 14th, 1899. For obtaining zinc, a zinc sulphate solution is divided into two parts, one part being circulated through all the anode compartments and the other through all the cathode compartments. The solutions leaving the vat are mixed, and brought up to strength for re-use by dissolving fresh zinc ore. The anodes are of lead or silver-plated, and the cathodes of aluminium, about 6 mm. thick and rounded at the corners and edges. Parchment diaphragms are used. 3 claims.

22,754. "Improvements in or connected with alternating arc lamps." W. J. Davy. Dated November 14th, 1899. To reduce the noise produced by an alternating current arc lamp, its frame and casing are separately suspended by springs, or by straps or other flexible connections from a top plate and this is similarly suspended from a support. 2 claims.

6,002. "Receiving apparatus for so-called Hertzian waves for transforming same into perceptible signs." J. C. Schafer, E. Renz, and P. Leppold. Dated March 20th, 1899. Apparatus for use as a coherer is formed of sheets of metal mounted on or between layers of insulating material. When mounted on the insulating material spaces are left between the sheets. The air in the chamber is kept damp by various means. 5 claims.

16,889. "Improvements in electrical transformers." A. F. Berry. Dated August 19th, 1899. The windings are made from a cable composed of several wires insulated from one another. Certain of these wires are connected to form a primary, and the others to form the secondary. A transformer built up on cores such as described in Specification No. 9,457, A.D. 1897, is shown in the drawings. 3 claims.

16,922. "An improved electric spark fuse." G. G. M. Hardingham. (O. R. Schulz.) Dated August 21st, 1899. In one form the electric igniting wires are bridged by a strip of paper wound round the wires, and carrying a conducting strip of lead foil. In another form the lead foil is carried between two paper strips, and is wound in and out of the wires. 8 claims.